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The Journal of HEREDITY

A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics

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The American Genetic Association

An incorporated organization devoted to promoting a knowledge of the laws of heredity and their application to the improvement of plants, animals, and human racial stocks.

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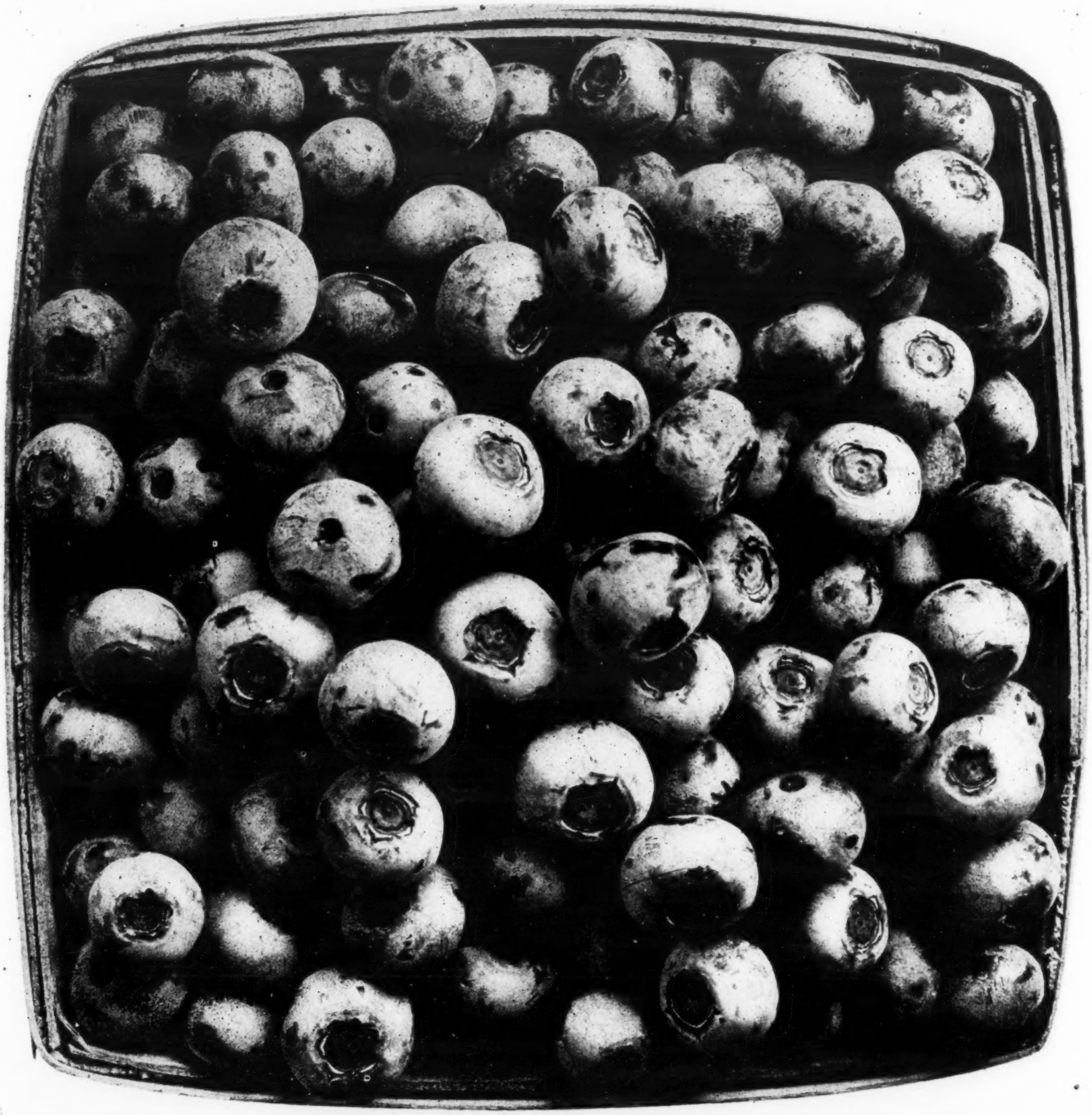


A NEW HYBRID—THE KATHARINE BLUEBERRY

The illustration shows, in natural size, a quart box of fruit from a new hybrid blueberry which is given the variety name Katharine. The variety is a first generation hybrid between two selected wild plants of the highbush blueberry, *Vaccinium corymbosum*. One of these parents, known in our records as Brooks, was from Greenfield, N. H. The other parent, known as Sooy, was from Browns Mills, N. J. About 3,000 hybrids of this parentage, from pollinations made in the greenhouse at Washington in 1912 and 1913, have been fruited at the blueberry testing plantation at Whitesbog, four miles east of Browns Mills, N. J., which is under the supervision of Miss Elizabeth C. White. The best hybrid among these 3,000 is the one here illustrated. The photograph, taken July 18, 1918, shows a clean picking of all the berries that were ripe on the bush at that date, small as well as large ones. Less than 3% of the berries, by count, were under half an inch in diameter. The largest was ¾ of an inch. The berries have a light blue color, delicious flavor, and firm texture, and the seeds are so small as to be scarcely noticeable when the berries are eaten. Propagation material of this variety has been given to several nurserymen, as hybrid 830C, and plants should be available within a year or two. The type specimen of the variety has been deposited in the Economic Herbarium of the U. S. Department of Agriculture and a colored drawing of its fruit has been filed in the records of the American Pomological Society, in Washington. The name Katharine is given in honor of my daughter, Mrs. Katharine C. Woodburn, now of Des Moines, Iowa, who took a deep interest in the development of the blueberry and at one time did all the pollination work.—Frederick V. Coville, United States Department of Agriculture. (Frontispiece.)

IS RACE SUICIDE POSSIBLE?

ALEXANDER GRAHAM BELL
Washington, D. C.

ONE of the most interesting of the questions of today relates to the powerful influence exerted upon populations by what we might almost call negative selection. A selection that produces the very opposite of that expected.

For example, no inheritable peculiarity associated with lack of offspring can be made to grow and flourish in a community. In spite of all efforts it will languish, and promote the growth of its very opposite. History is full of illustrations.

CELIBACY

After the fall of the Roman Empire there was a great religious revival among the nations. The Middle Ages saw Europe filled with monasteries and nunneries, where enormous numbers of people took vows of celibacy, and renounced all home and family ties. Even outside of the religious houses the *celibate life* was everywhere held up as the ideal one to be followed by the best and purest elements of the population.

Instead of helping the church this produced the very opposite effect, and actually paved the way for the Reformation! Large masses of the people who were most attached to the Church led celibate lives, and left no descendants, whereas the independently minded who were not so devoted to the Church were not limited in their reproduction.

As to the more general effects it may be safely said that the worship of celibacy during several hundreds of years in the past has not tended to the improvement of humanity but the very reverse; for, where the best and noblest led celibate lives, they left no descendants behind them to inherit their virtues, whereas the worst elements of the population continued to multiply without restriction.

It is now felt that the interests of the race demand that the best should marry and have large families; and that any restrictions upon reproduction should apply to the worst rather than to the best.

It is of course useless to expect that the worst would take vows of celibacy or keep them; and the realization of this has led to all sorts of impracticable schemes to prevent or restrict their reproduction by compulsory means.

The great trouble about all these schemes, apart from their impracticability, is that they aim simply to prevent degeneration. They aim to prevent the race from moving backwards, but do not help it to move forwards. The only hope of producing higher and better types of men and women lies in the multiplication of the better elements of the population.

There is one very promising feature about the present situation, and that is that the best are readily attracted by high ideals. Give them a new ideal, and many will follow it, especially if they believe that duty points in the same direction. Convince them that the interests of the race demand that the best should increase and multiply; convince them that it is therefore their duty to marry, rather than lead celibate lives. Depose "celibacy" from the high and commanding position she has occupied for so many hundred years, and put "marriage" there instead as the ideal to be held up before the best and noblest of the race. Marriage, with marriage vows as sacred as the former vows of celibacy. Nature demands this in the interests of the race. For the extreme helplessness of the human infant necessitates parental care for very prolonged periods of time—in fact at least from infancy to the beginning of adult life—and this involves the permanency of the marital tie on the part of the parents, especially where a number of children are produced.

RACE SUICIDE

At the present time considerable alarm has been expressed at the apparently growing disinclination of American women to bear children, and a cry has been raised against what people call "Race Suicide." Whatever the cause—it is undoubtedly the fact that in America the children of foreign-born parents are increasing at a much greater rate than the children of native-born parents—and the position is sufficiently grave for serious consideration.

The desire to avoid maternity is a characteristic associated with lack of offspring, and cannot therefore go on increasing indefinitely in a community. Its natural tendency is to die out through lack of offspring to inherit it, leaving the more fertile part of the community alone to propagate the race.

Reflection therefore leads to the somewhat startling conclusion that even wholesale abstention from children, so far from lessening the fertility of the community as a whole will eventually increase it instead. Actual race suicide will not result from such a cause alone, so long as the race is left to itself to work out its own destiny.

Just consider the case of a race of people in which the women show a disinclination for motherhood, surrounded by prolific immigrant races ready to take its place, then of course there would be serious danger of the native race being displaced by the immigrants. The immigrants might absorb the native race instead of the native race absorbing the immigrants; but such a result would be due to the presence of the competing races and not due directly to the operation of natural causes within the race itself.

THE DESTINY OF AN ISLAND RACE

In order to appreciate this, imagine our native race to be placed upon an island protected by suitable immigration laws from competition with other races. Then it becomes obvious that the sentiment in favor of avoiding the production of offspring must necessarily diminish in process of time, on account of the lack of offspring to inherit it; and that the opposite sentiment of a desire to have children will grow, and ultimately become predominant, because each succeeding generation will be composed exclusively of the descendants of the people who had children. If the desire for offspring is an inheritable characteristic, *and it certainly is*, then of course the next generation will inherit it from their parents to a certain extent; whereas there will be no descendants at all to inherit the characteristics of those who abstained from offspring.

We have placed the people upon an island, and protected them from interference from other races, so as to leave them to themselves to carry on their lives in their own way, as they desire.

Some of these people love little children, and desire to have children of their own. Others look upon children as nuisances, perhaps necessary evils for the continuance of the race—but why should they be bothered with them when they don't want them? Let others have them if they want them, but leave *them* alone. Well—let them have their desires.

Let those who desire children have them, and those who don't, have none, and see how it will all work out.

Now does it not become at once evident that so long as any of the people desire offspring and have them, complete race suicide is impossible? Some offspring will be produced and a second generation will appear.

Suppose for example the boom against maternity reaches such proportions that 99 per cent of the population decide to have no children—and surely this is an extreme case—will the race die out? No—not immediately at all events. There will be another generation composed exclusively of the descendants of the one per cent who desire to have children. The whole of the next generation will be composed of their children; and there will be no descendants at all of the other ninety-nine per cent.

This is the critical time for our islanders. Only one per cent of the

population have had children, and of course the numbers in the next generation will be so seriously reduced that immigration from outside would speedily swamp them—but we have agreed to protect them from this competition with other races, and leave them alone to work out their destiny to the bitter end.

Well, let us revisit the island after the original population has passed away. We find the population now only a fraction of what it was before; and the question naturally arises: will the population continue to diminish at each successive generation until actual race suicide results?

It is not to be supposed that the sentiment against maternity will disappear in one generation. The second generation will therefore undoubtedly continue to be divided upon the question of maternity; some wishing to have children, others not; but the *proportion* desiring children will necessarily be greater, on account of heredity, than in the original population; for the whole of this second generation are descended from the one per cent who desired offspring, whereas the ninety-nine per cent who did not desire them left no descendants.

There seems to be no escape from the conclusion that in this second generation more than one per cent of the people will desire children, and less than ninety-nine per cent will abstain from their production. Therefore the proportion of the second generation who will have children will be greater than in the first, and the proportion opposed to maternity will be less.

Thus in each succeeding generation the proportion who desire children and have them will increase, and the proportion avoiding maternity diminish, with the net result that each succeeding generation will be more fertile than the last. The desire to avoid maternity will die out to a great extent on account of the lack of offspring to inherit it. *The spirit of race suicide will itself commit suicide, and leave a more fertile race than before.*

The only thing that could prevent such a result would be: the admission of immigrants during the period of declining birthrate.

This indeed is the critical period in the history not only of our hypothetical islanders, but of every nation similarly situated. When therefore a nation reaches a stage where it finds its own birthrate declining, and immigrants with a much larger birthrate flocking into the country, the time has come for very serious consideration as to the means to be taken for self-preservation.

The United States is today in this critical position. The birthrate of America is declining; the spirit of avoiding maternity is on the increase; and the immigrant races are increasing at a much greater rate than our own. The only hope for a truly American race lies in the restriction of immigration.

EUGENICS AND PATRIOTISM

"Race has played a far larger part than either language or nationality in moulding the destinies of men; race implies heredity, and heredity implies all the moral, social and intellectual characteristics and traits which are the springs of politics and government. . .

"The moral tendency of the heredity interpretation of history is for our day and generation, and is in strong accord with the true spirit of the modern eugenics movement in relation to patriotism, namely, the conservation and multiplication for our country of the best spiritual, moral, intellectual and physical forces of heredity; thus only will the integrity of our institutions be maintained in the future."

—*Henry Fairfield Osborn.*

A HEN WHICH CHANGED COLOR[1]

A Note on the Hereditary Behavior of a Normal Blue Andalusian Hen Whose Feathers Changed to Snowy White

WILLIAM A. LIPPINCOTT
Kansas Agricultural Experiment Station, Manhattan, Kansas

CASTLE and Phillips' (1911) studies on ovarian transplantation in guinea-pigs have been most useful as classroom illustrations of the separateness of the soma and germ-plasm. They have conveyed to the elementary student as no amount of explanation might, just what the underlying principle of Weismanns' (1893) great concept was. These results are too familiar to biologists to need review.

In connection with a study of the inheritance of blue in poultry, the writer has observed a marked somatic change in a blue Andalusian hen, which, as was to be expected, did not in any way change the gametes she produced. Because the change was a rather striking one and might serve as an example of the independence of the body-plasm and germ-plasm from another point of view, it has seemed worth while to give a detailed account of the case.

What appeared to be a normal blue Andalusian hen was turned over to the writer in the early spring of 1917 by Professor J. G. Halpin of the University of Wisconsin. She came from the flock of the University Poultry Department and was then almost two years old. This hen was from a pedigreed family, among the members of which nothing unusual had been noted. She carried the University legband number C2032, and was, among others, used in breeding work carried on at the University during that spring.

In August 1917 she was taken to Kansas State Agricultural College at Manhattan where she has since been kept on the farm of the Department of Poultry Husbandry.

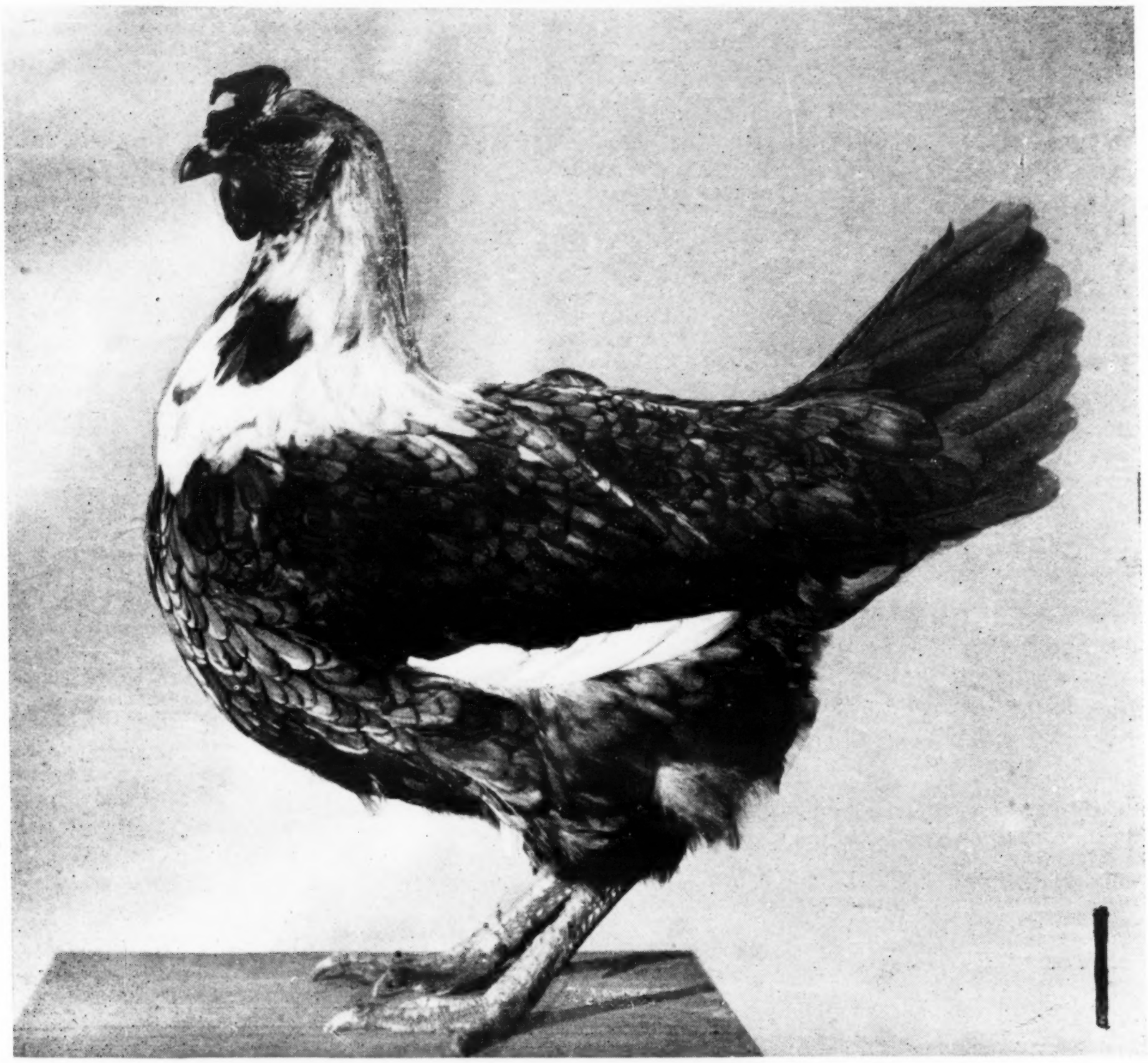
In October 1917 it was observed that white feathers were appearing on her neck and a little later that her developing primaries also were white. It was noted that new feathers were coming in in other regions of the body which were the normal blue, and by December 1st it was apparent that she had completed her molt for that season.

Her appearance on December 20, 1917, is shown in Fig. 1. There was no further noticeable change until the following July when it was observed that she was again in full molt, her old feathers both blue and white being replaced only by white. Photographs taken August 7, 1918, may be seen in Figs. 2, 3 and 4, which show her during the progress of her molt. Six weeks later she was snowy white throughout (Fig. 7). She has since never displayed a blue feather and is now (October 1920) in apparent good health and laying occasionally.

CAUSES OF COLOR CHANGES

Supposing that similar color changes among domestic birds were not uncommon, a search of the literature was made. While it has not been exhaustive, the writer has been surprised not to find, in the journals at his disposal, accounts of similar changes. The account of Finches' (1908) hen indicates that the color change was first due to loss of pigment from the feathers after growth and not to a failure of the pigment-manufacturing mechanism to function. The color change came after, and not as the accompaniment of, a molt. During a subsequent molt pigmented feathers were grown which later turned white. Whether the pigment forming mechanism was somewhat interfered with during this molt, or the bird passed through a partial molt only, is not clear.

[1] Contribution from the Department of Genetics, Wisconsin Agricultural Experiment Station, No. 25 and from the Department of Poultry Husbandry, Kansas Agricultural Experiment Station, No. 16.



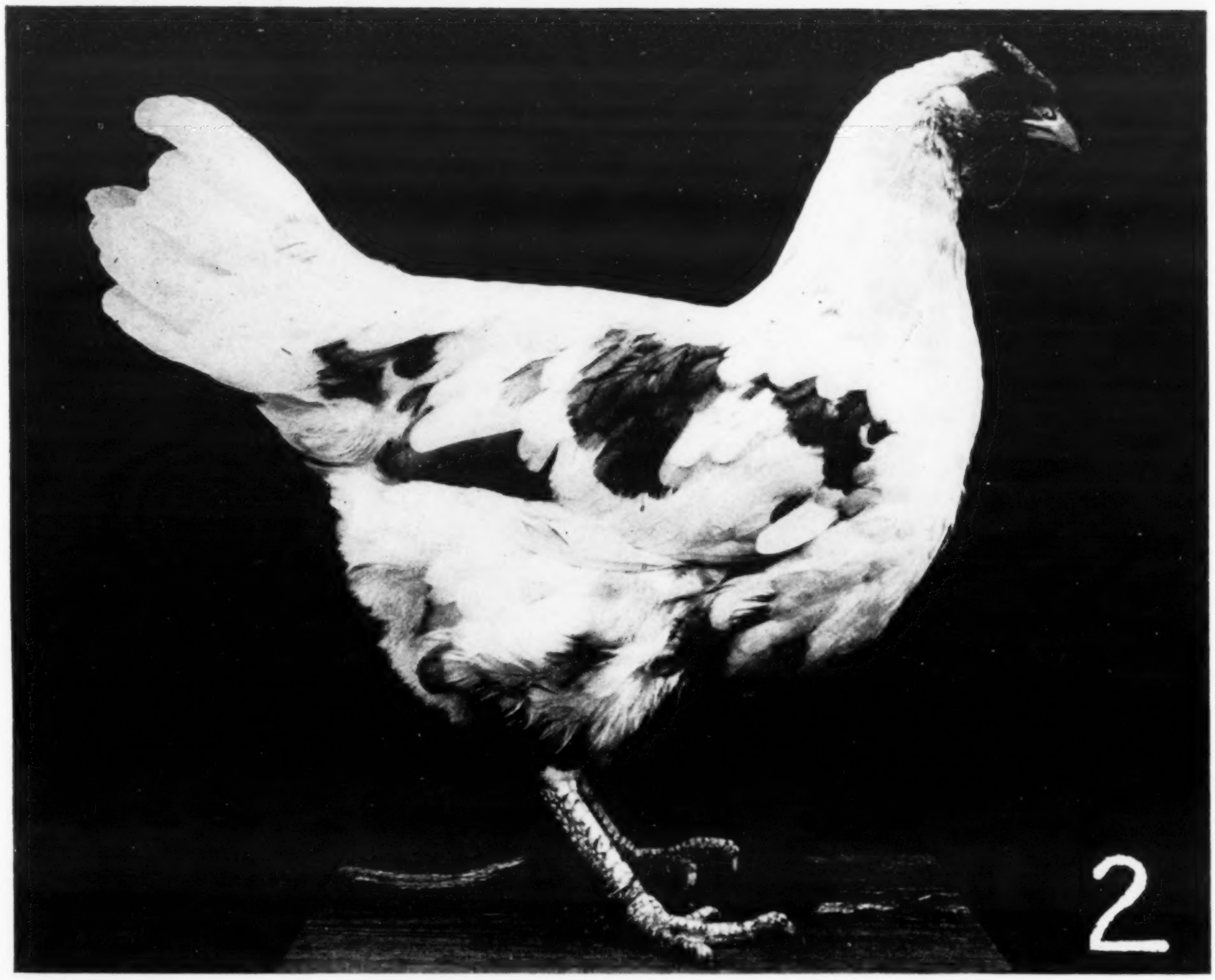
BLUE ANDALUSIAN HEN (C2032) CHANGING TO WHITE

This hen, from the University of Wisconsin Poultry Department, was considered in the spring of 1917 to be a normal blue Andalusian. In October of the same year white feathers appeared on her neck. The illustration shows her as she appeared December 20, 1917, after completing that season's molt. Photograph by James Machir. (Fig. 1.)

The particular interest in the case in hand arises not alone from the fact that the subject changed color but that in addition her ancestry and breeding performance are known.

As shown by Lippincott (1918) blue Andalusians are usually of the genetic constitution *PP* (*Re*) (*rE*). *P* is a factor necessary for the production of black pigment. Its allelomorph *p* produces a recessive white. *R* is a dominant, acting on black pigment, restricting its distribution in such a way as to give a characteristic bluish gray appearance. *E* is a dominant factor rendering an individual carrying *P* self colored. Self-blue is the result of the combined action of *R* and *E* on black pigment. For reasons developed in the paper noted, and in a further paper soon to be published, it appears reasonable to assume that *R* and *E* are each closely, perhaps completely, linked to the allelomorph of the other, hence written (*Re*) and (*rE*).

As shown earlier by Bateson and Punnett (1906), when blue Andalusians are mated *inter se* they produce blacks, blues, and white-splashed, in the ratio of 1 to 2 to 1. Genetically the reason



THE BLUE ANDALUSIAN HEN (C2032) EIGHT MONTHS LATER THAN FIG. 1

"There was no further noticeable change (from the condition shown in Fig. 1) until the following July when it was observed that she was again in full molt, her old feathers, both blue and white, being replaced by only white." These three views show the hen as she appeared August 7, 1918. No. 3 is a front view. A comparison of the two sides with regard to the order in which the blue feathers were dropped is a matter of considerable interest to poultrymen. Was the change in color due to loss of pigment from the feathers after growth or to a failure of the pigment-manufacturing mechanism to function? Photographs by James Machir. (Figs. 2 and 3.)

for this is shown in the following cross.

Blue Andalusian ♂ X Blue Andalusian ♀

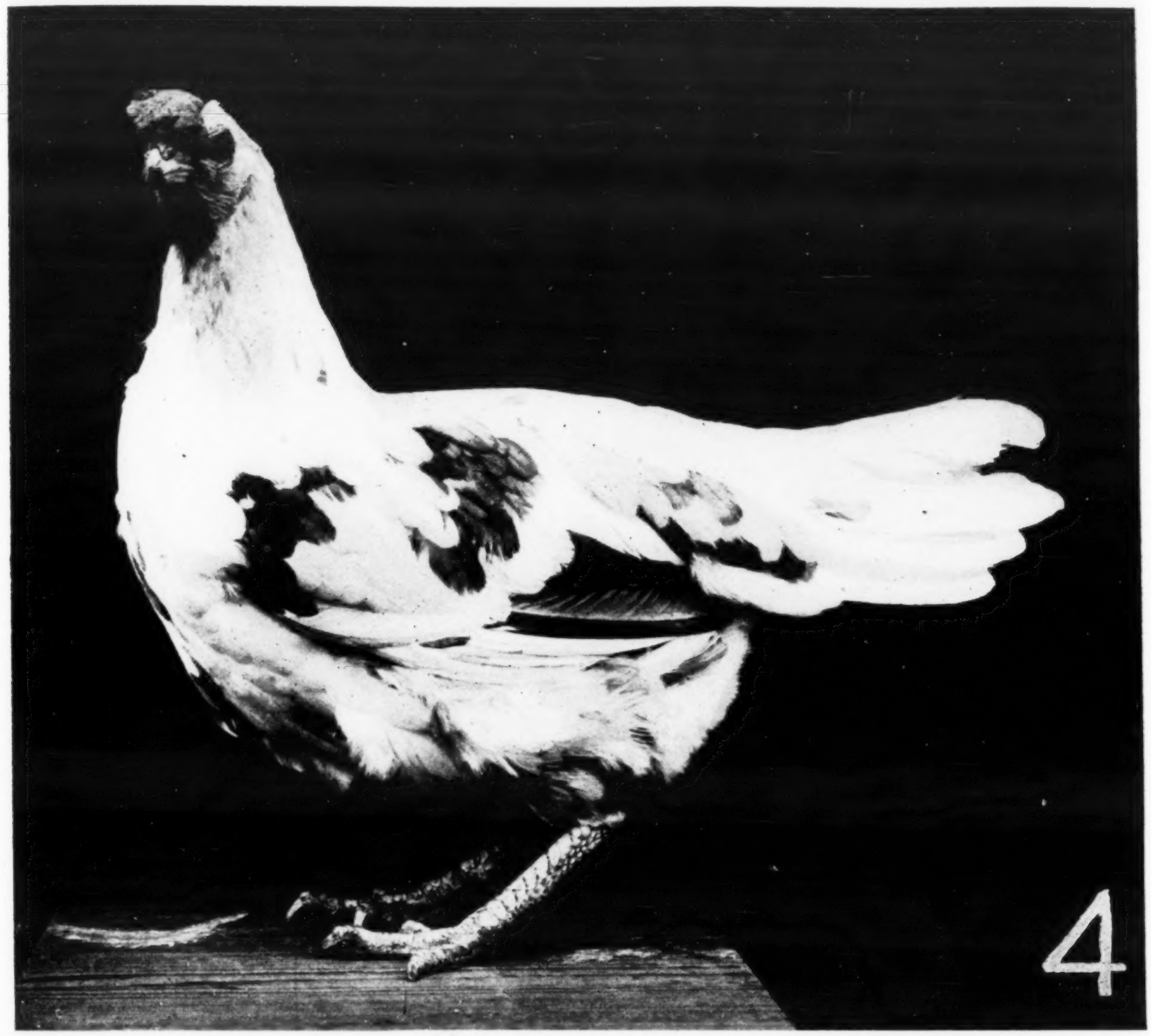
PP(*Re*)(*rE*) *PP* (*Re*) (*rE*)

Offspring
- 1*PP*(*rE*) (*rE*) black
- 2*PP*(*Re*) (*rE*) blue
- 1*PP*(*Re*) (*Re*) white-splashed

The white-splashed individuals, as would be expected if the symbolism proposed is correct, are splashed with blue, and sometimes referred to as blue-splashed.

RESULTS OF BLUE AND WHITE MATINGS

During the spring of 1917 before C2032 had exhibited any tendency toward a color change, she was mated to a blue Andalusian, ♂ S19, from the



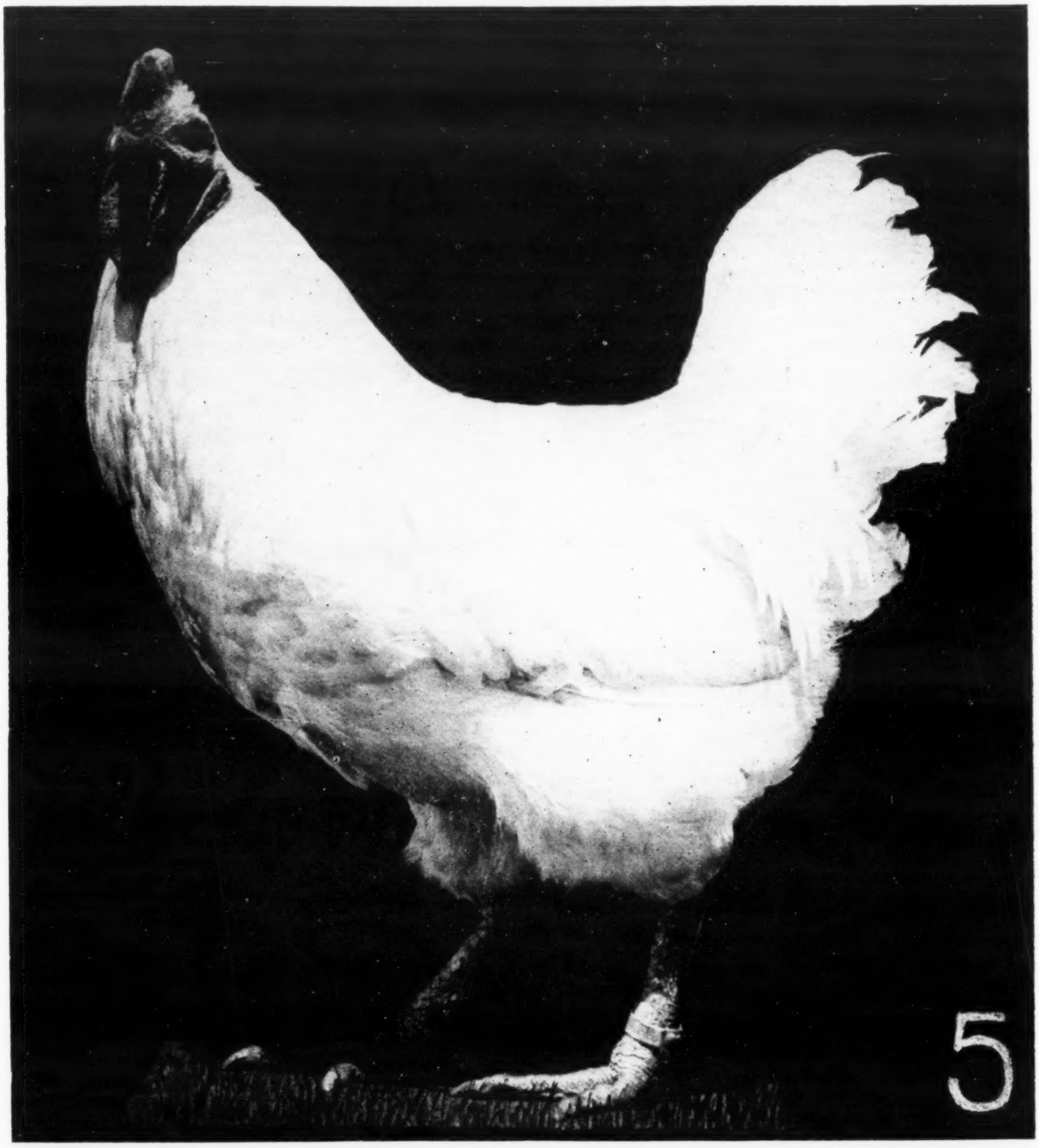
LEFT SIDE VIEW TAKEN SAME TIME AS THOSE ON OPPOSITE PAGE

The photographs on this and the opposite page were taken August 7, 1918, eight months later than the photograph reproduced in Fig. 1. Six weeks after the above condition obtained, all the feathers had changed to snowy white, a condition which the hen has retained to the present time. See Fig. 7. (Fig. 4.)

University of Wisconsin flock. But five chicks here hatched, of which one was blue-splashed and four were blue, the theoretical expectation being 1.25 splashed, 2.50 blue and 1.25 black.

The following year, 1918, while in the condition, as regards color, shown in Figure 1, she was mated with white Wyandotte ♂118M from the Kansas State Agricultural College flock. As shown in an unpublished paper the genetic constitution of 118M was $pp(rE)(rE)$, so far as the factors under consideration are concerned. The expectation from such a mating would be equal numbers of blues and blacks. Twenty eight chicks were hatched, of which thirteen were blue and fifteen were black.

The next breeding season, 1919, after C2032 had become pure white, she was mated to a white Plymouth Rock ♂155 M (see Fig. 5). Twenty five chicks were hatched, of which seven were blue and eighteen were black, the theoretical expectation being 12.5 for each color. This deviation is probably not significant since $\frac{\text{Dev.}}{\text{P.E.}} = 3.2$. A black and a blue chick, offspring of this mating, are shown in Figure 6.

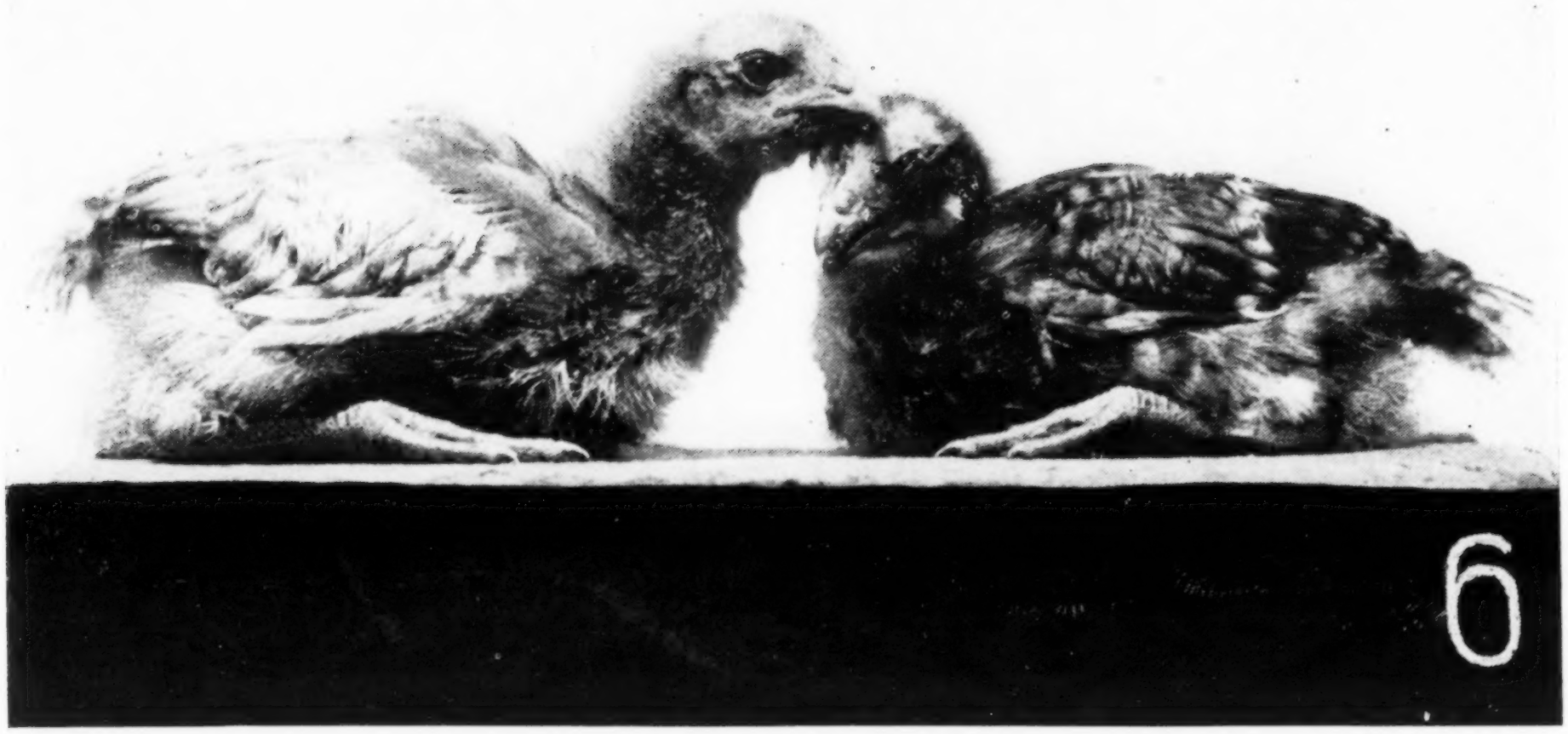


A WHITE PLYMOUTH ROCK (155M)

During the breeding season of 1919, the blue Andalusian Hen (C2032), after she had become pure white, was mated to this White Plymouth Rock (155M). Out of twenty-five chicks hatched, seven were blue and eighteen were black. Two of the offspring are shown on the opposite page. Photograph by James Machir. (Fig. 5.)

During the breeding season of 1920 she was mated with white Wyandotte ♂206M. This bird was similar in genotype to 118M and 155M except that he was heterozygous for I^P (inhibitor of pigment), a factor for dominant white. Nine chicks were hatched of which three were blue, four were black and two were white. The theoretical expectation would be 2.25 blue, 2.25 black and 4.50 white.

It is evident that C2032, though snowy white, was continuing to breed as a blue Andalusian. A genetically recessive white female mated to the white Plymouth Rock used would have



A BLUE-BARRED AND A BLACK-BARRED CHICK

These two chicks were among the offspring from the mating of white Plymouth Rock 155M and blue Andalusian C2032 during the season of 1919. The barring factor was brought in by the male. "It is evident that C2032, though snowy white, was continuing to breed as a blue Andalusian." Photograph by James Machir. (Fig. 6.)

produced only white chicks, unless it was the kind of white peculiar to the Japanese Silky. A genetically dominant white female would also have produced only white offspring, if she were homozygous. If she were heterozygous dominant white but homozygous for *P*, half her chicks by a white Plymouth Rock would have been white and half pigmented. Other possible combinations might be suggested, but none fits the case except the assumption that she is genetically a blue Andalusian though a beautiful snowy white in appearance. A similar conclusion is reached from the results of her mating with white Wyandotte ♂ 206M. A photograph of the hen after she had become completely white is shown on the following page.

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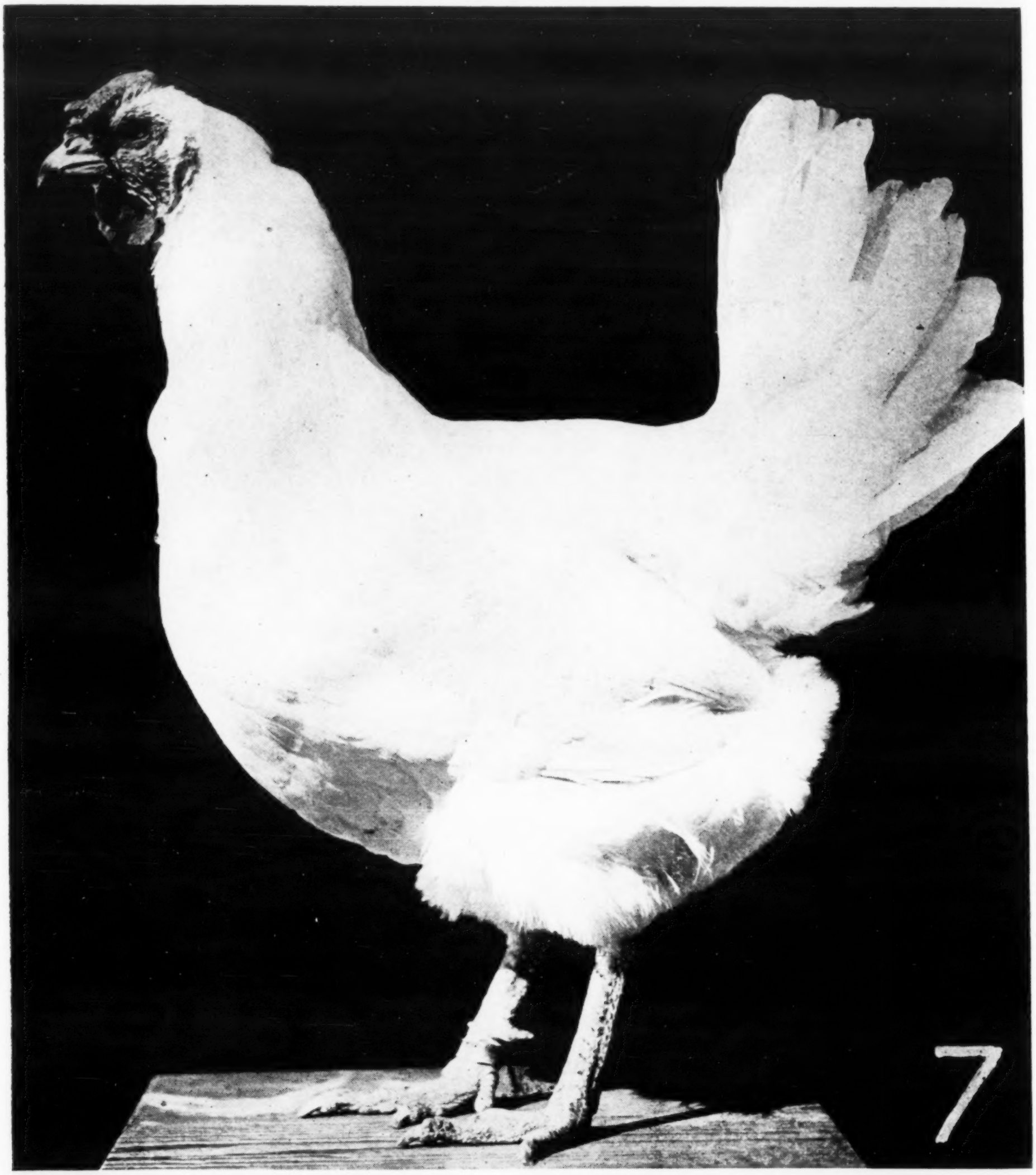


BLUE ANDALUSIAN HEN (C2032) CHANGED TO SNOWY WHITE

This photograph was taken September 21, 1918 after the hen had completed her annual molt, and shows her condition six weeks after that illustrated in Fig. 4. She has since remained snowy white, is in apparent good health, and lays occasionally. Photograph by James Machir. (Fig. 7.)

HERITABLE CHARACTERS OF MAIZE

VI. ZIGZAG CULMS[1]

WILLIAM H. EYSTER
New York State College of Agriculture, Ithaca, N. Y.

THE plant abnormality known as "zigzag culm" andd escribed in this paper, was first noted by Dr. R. A. Emerson in a number of F_4 cultures of a cross between Tom Thumb pop corn and a Missouri dent corn.

Some of the families in which zigzag culm was first found were breeding true for this peculiar type of stem so that it must have occurred in earlier generations without being detected. At first it was thought probable that this is another example of a mutation having occurred in a pedigree culture but the fact that zigzag plants have been found in the progenies of two different F_2 plants makes it much less likely. Dr. Emerson self-pollinated a number of plants and found that they breed true for the zigzag culm. He also found that when he crossed them with plants with normal culms the F_1 plants are apparently perfectly normal. Because of the many other problems that were demanding his attention Dr. Emerson asked the writer to investigate further the inheritance of this culm abnormality.

DESCRIPTION OF ZIGZAG CULM

In the early life of the plant it is not possible, at least so far as external appearances go, to identify the individuals which are destined to have zigzag culms. The character first becomes apparent about the time the plant comes into tassel. The first indication is what seems to be a flattening and broadening of the culm in the ear shoot region. This apparent flattening is due to the pulling away of the leaf sheathes from the culm. Within a remarkably short time the character is fully expressed and the plants appear as shown in the accompanying illustrations.

In Figs. 8, 9, and 10 are shown zigzag plants. It will be seen that these plants are more or less dwarfed, with the culm in the ear shoot region strongly zigzag and consequently pulled out of the leaf sheathes. Fig. 8 shows an entire plant, while in Figs. 9 and 10 only a part of the plant is shown. As these photographs were all taken from the same positions it is evident that the first plant is more dwarfed than the other two plants. The amount of dwarfing depends upon the number of internodes affected and the degree of the modification. The leaves are apparently normal except that the sheaths are pushed apart so that they do not clasp the internodes as they do in normal plants. A normal plant of the same pedigree culture is shown in Fig. 11.

In many zigzag plants the internodes affected are many times shorter than their leaf sheathes and often the sheath stands off at right angles to the internode, as shown in Figs. 9 and 10. The plant shown in Fig. 8 had a number of its internodes so much shortened that the long leaf sheathes overlapped to an unusual extent in the region affected. In Fig. 13 is shown the same plant with the leaves cut away so as to expose the stem. The leaves of the normal plant shown in Fig. 11 were likewise removed and the culm photographed as shown in Fig. 12. The internodes of the zigzag plant are not only shortened but much thickened. Apparently there is more rapid growth on the side of the internode above the leaf attachment which causes the internode to arch away from the leaf sheath. As alternate inter-

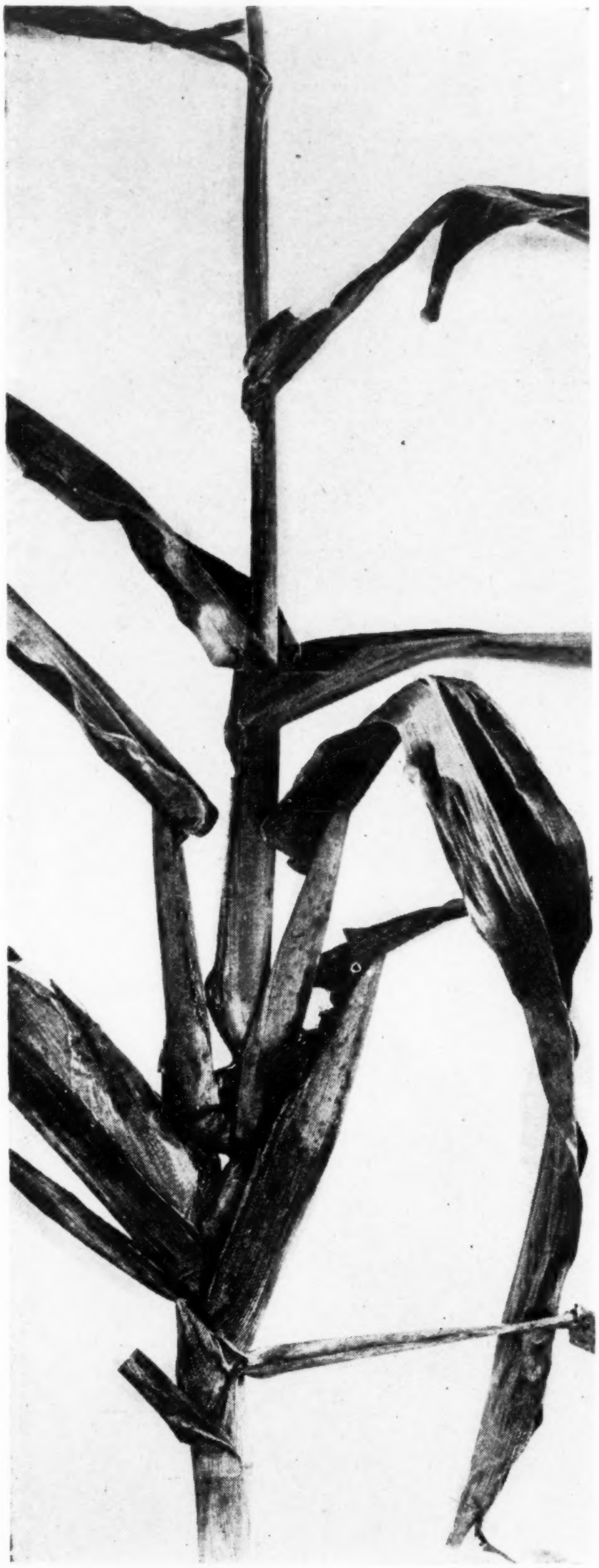
[1] Paper No. 84, Department of Plant Breeding, Cornell University, Ithaca, New York.
Photographs by I. W. Fisher, Department of Plant Breeding, Cornell University, Ithaca, New York.

A MATURE MAIZE PLANT HAVING A ZIGZAG CULM

Zigzag culm is an inherited plant abnormality which was at first thought to be another example of mutation, but later observations make this appear unlikely. The effect of zigzag culms, as one would expect, is to dwarf the plant in varying degrees depending on the number of internodes affected. This plant is extremely dwarfed because of the large number of internodes affected. The leaf sheathes overlap greatly in the ear shoot region because of the shortness of the internodes. (Fig. 8.)

ANOTHER PLANT WITH A ZIGZAG CULM

The zigzag character does not appear in the early life of the plant, and only becomes apparent about the time the plant comes into tassel. Then there is a pulling away of the leaf sheathes from the culm, but the leaves themselves are otherwise normal. This plant shows three internodes that are no longer clasped by the leaf sheathes. (Fig. 9.)



ZIGZAG CULM WITH UPPER AND LOWER INTERNODES APPARENTLY NORMAL

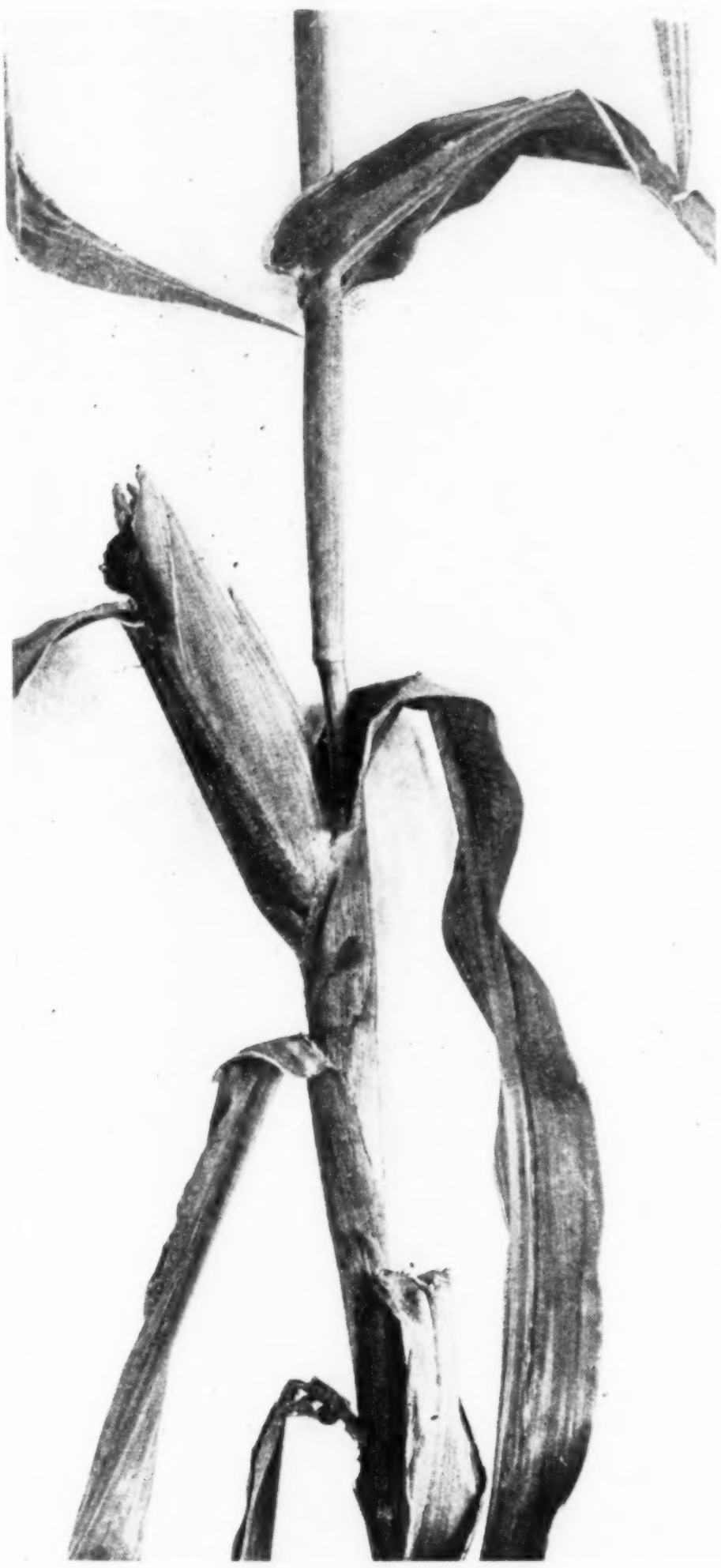
Usually only the internodes in the ear shoot region are affected. Note how the leaf sheathes stand off at right angles to the affected internodes. The plants are apt to break at these internodes, but otherwise they appear as vigorous under field conditions as normal plants. (Fig. 10.)

nodes have the leaves attached at opposite sides the result is a more or less zigzag stem.

Extracted recessives from crosses vary considerably in the expression of the zigzag character. In Figs. 14, 15, and 16 are shown such extracted recessives. The plants shown in Fig. 14 are quite distinctly zigzag and somewhat dwarfed. The short twist high on the stem of the second and third plants in Fig. 14 is another plant abnormality which will be described in another paper. So far as known at present it is inherited independently of zigzag culm. Other less extreme plants are shown in Fig. 15. Such plants can very easily be recognized when mature by stripping away the leaves in the ear shoot region. The plants shown in Fig. 16 were selected to show how closely some zigzag plants approach normal plants in appearance. Such plants are not perceptibly dwarfed as the internodes are only a very little or not at all shortened, even in the ear shoot region. After some experience such plants can easily be identified after removing the leaves. It will be noticed that in each of the plants shown in Fig. 16 a number of the internodes are arched away from the point of leaf attachment. Comparison of these culms with the culm of a normal plant as shown in Fig. 12 will make this clear.

INHERITANCE OF ZIGZAG CULM

Mention has already been made that zigzag culm was found by Dr. Emerson to be a recessive character. The writer also made many outcrosses with normal plants and in every case the F_1 plants were apparently normal. Several F_2 progenies were grown which gave a total of 343 normal to 23 zigzag plants. This is a very wide departure from a 3:1 relation which should obtain if zigzag culm is a simple mendelian recessive. There is, however, a deviation of only 0.1 ± 3.1 plants from a 15:1 relation expected when two factors are concerned in the expression of a character. This is an exceedingly close fit. In taking the notes each plant was entirely defoliated and its culm was carefully examined. In spite of the close agree-



A MAIZE PLANT WITH NORMAL CULM

SAME PLANT WITH LEAVES REMOVED

Compare these normal culms with the zigzag culms in the illustrations which follow. (Figs. 11 and 12.)

ment to the two factor hypothesis the questions arose as to whether the deficiency in zigzag plants might not be due either to my inability to identify some of them or to a high death rate because of inherent weakness. So far as I have observed zigzag plants are as vigorous under field conditions as normal plants except that they are more apt to break in the internodes that are no longer clasped by the leaf sheathes.

A number of F_1 plants were backcrossed with the zigzag parental type, and there resulted 373 normals and 104 zigzag plants, a deviation of 134.5 ± 7.4 from the equality expected when parents differ in a single pair of factors, but a deviation of only 15.25 ± 6.38 from a 3:1 ratio expected when parents differ in two pairs of factors.

These data indicate that zigzag culm comes into expression only when at least two factors are recessive, and is another case of plural genes. Crucial tests of the hypothesis are yet to be made.

SAME PLANT AS SHOWN IN FIG. 8 WITH LEAF SHEATHES CUT AWAY

It will be noted that the internodes in the ear shoot region are much shortened, thickened, and arched away from the side of leaf attachment. (Fig. 13.)

ZIGZAG CULMS OF THE MORE EXTREME TYPE

Comparison of these culms with the normal one shown in Figs. 11 and 12, indicates plainly that the internodes of a zigzag plant are not only shortened but also considerably thickened, indicating a more rapid growth on the side of the internode affected. These are extracted recessives from crosses and, together with those in Figures 8 and 9, show that there is a considerable variation in the expression of the zigzag character. The short twist high on the second and third plants is another abnormality not of the zigzag character. (Fig. 14.)

ZIGZAG CULMS WITH FEW INTERNODES AFFECTED

These exhibit a much less extreme zigzag character than those in the previous illustration. Such plants are nearly as tall as their normal sibs but may be easily identified, especially by stripping away the leaves in the ear shoot region. (Fig. 15.)

ZIGZAG CULMS APPROACHING NORMAL CULMS IN APPEARANCE

These plants were selected to show how closely some zigzag plants approach normal plants in appearance. Their dwarfness is not very noticeable. Note the number of internodes that are arched away from the point of leaf attachment. Upon comparison with the normal culm shown in Fig. 12 the zigzag character which is here less distinctly expressed becomes evident. (Fig. 16.)

BETTER AMERICAN FAMILIES—IV

A Brief Story of Several American Families Which Have Contributed Noteworthy Leaders in the Development of Our National Life[1]

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MANY of us, as we look into the face of America today are wondering what this face will be like a few generations hence. Such a confusion of prophecies strikes our ears, prophecies in which the customary optimistic note is discouragingly lacking! In the turmoil that has succeeded the war, ugly elements have come to the surface of our national life, menacing possibilities which never before were suspected of existing here.

Earnest people are everywhere asking: "Is this, our boasted many-sided civilization, to prove a scandalous failure in the hour of its greatest success? How shall we bring harmony into warring ideals and unity into the divergent purposes of our multitudinous population? How are we to so solidify our national life as to present an immovable bulwark to a foe that continues to threaten now within as well as without our gates? For we know that on our success in conferring a genuine naturalization on the alien, depends our success in the experiment of making democracy safe for ourselves and the world.

WHAT FORCES ARE SHAPING THE NATION?

The half century that succeeded the Civil War marked a fabulous growth in national wealth and power; it witnessed an astounding march of settlement till a vast continent was subdued, and an extension of industry, through a rule of coal-barons and steel-kings over millions of aliens thrust full-grown into the fabric of our national life. This has meant, largely, progress by masses of mechanical power, the furnace, steam and electricity. While the workers show capacity to manage these forces, the function of internal government has become the task of controlling these men, many of whom have remained as remote from a truly American spirit as though they had never touched our shores. If our present time of "taking stock" brings us any vision of the forces that have made America, and the processes that should shape a nation, if it ever so slightly directs our wills to a conscious shaping of these processes, it will have been worth all the agonies it is costing us.

It is perhaps not generally known that this nation passed through a similar period of turbulence in the years following the Revolution, particularly in the period of French Terrorism. The Constitution was adopted and the present government put into operation at a time when there was not a grammar, a geography or a history of any kind in the schools, and when a teacher who could compute interest was considered "great in figures." In thrifty New England, idle men loafed on street corners while women and children went in rags; the outposts of settlement were largely held by a nomad race, part farmer, but mostly hunter, who housed there numerous broods in filthy cabins, and held as the highest ideal, complete unrestraint from all social and governmental control. Franklin declared the press of the day was supported by human depravity, and Knox wrote Washington that in Massachusetts, those who opposed the Constitution acted "from deadly principle levelled

[1]This is the fourth in a series of five articles on this subject by the same author, the former papers having appeared respectively in the January, February and March 1919 numbers of the JOURNAL OF HEREDITY.—Editor.

at the existence of all government whatsoever."

Yet at this time there were parts of the country where order and sobriety were the rule. New England, in its more thickly settled portions, was thrifty and industrious, New York and Pennsylvania had their prosperous, well-cultivated valleys, and farther south, worthy elements of the population gradually gained ascendency over the drinking law-denouncing settlers. In the pioneers who took up the farms abandoned by the first haters of civilization, we find representatives of our best colonial and old-world stock, who speedily displaced the improvidence and dissipation by piety, enterprise and thrift; also, they founded colleges and academies—off-shoots of the half-dozen which had held their own through a century in the East, where educated and devout men carried a lamp of learning and an inspiration to right living.

GENETIC FACTORS IN AMERICANIZATION

In previous papers we have sought a genetic interpretation of the process of Americanization. We have found its essence to consist in an ever greater approximation to standards and ideals set by certain regnant personalities. The completeness of the approximation is of necessity dependent on the native bent of the lesser families, thus having its foundation in the genetic constitution of the strains to which these families belong. These strains have not necessarily been derived from colonial stock. In the hordes of immigrants which the steerage disgorged on our shores annually through a dozen decades, there have been those as surely predestined to become "good Americans" as ever were fore-ordained to an apostolic succession. There have been Italians and Germans, Scandinavians, Jews and Serbians born in the American spirit and unquestioningly giving allegiance to the best in American life. Added to these were others, less resolutely American, but who might nevertheless have become so by contact with the best instead of the worst in our institutions.

We have found, then, as a necessary fundamental in Americanization, certain genetic factors conditioned through right marriages which insure the basis for the educative process. We have seen how social selection has brought together the fittest representatives of mixed strains through their migrations for a common purpose, and by their mating produced endowment above the average. In similar fashion the less able, left behind in the old environment have all too often, mated and given rise to a variety of defective and degenerate conditions.

In certain families which have been intensively studied, this process is seen extending over six and seven generations, resulting in well-defined socially fit and socially unfit lines, and we are justified in holding that almost any family whose history is scrutinized for a number of generations will show a like breaking up into lines of varying social efficiency.

While the need of cutting off defective and degenerate lines is becoming widely recognized and is being met by legislative enactment, there is as yet little organized effort to direct the evolution of lines among our mediate and superior classes. In this vaster attempt, the enlightened individual conscience must be appealed to. The heightening of our sense of social responsibility in marriage should be one of the beneficient effects of the world-war. The knowledge that a faulty heritage due to unwise matings played a major rôle in the production of the war-neuroses, thereby rendering the individual a liability rather than an asset in time of national stress, should bring home, as never before, individual responsibility to the state in the choice of marriage mates. Further, to see how a superior heritage due to fortunate alliances has meant a finer endowment, which in the favoring environment of the better lines has flowered into various forms of pre-eminence, should give an incentive to increase social worth

by this means as by the more universally recognized means of education.

INHERITANCE OF ABILITIES

Concluding this article is a genetic classification of American strains. The families already considered in papers II and III of this series belong to classes having low and mediate social worth. It is now proposed to consider certain American families of superior and superlative worth and the part which inheritance played in making such worth possible.

If we take up the genealogy of any family whose name suggests eminence in some lines, we are struck by the recurrence in successive generations of similar abilities, or at least of occupations which would imply similar abilities. While the majority of persons described are more or less obscure, still we are apt to find here and there what might be termed concentrations of various types of ability. Thus we find one line remaining tillers of the soil, another given to merchandizing, while still another shows several examples of artistic gifts. In the latter case the artistic ability may in certain branches "shade off" into a well-marked artisan group. Again, we find a decided altruistic bent for several generations, this evincing itself in the selection of the ministry as a life-work and the preference for the teaching profession. Often the occurrence of a name standing for pre-eminence of a particular kind is heralded by a number of lesser lights whose tastes and occupations give evidence of similarity of endowment. Many of the most interesting cases are where a gift which remained the avocation or pastime in a father becomes in the son the supreme endowment.

We have a fine example of this in the late E. A. Abbey. Asked how he got his first great commission, he gravely replied: "Through my grandfather." To the further question: "You are going to decorate the Capitol of Pennsylvania; did your grandfather get you that commission too?" he said: "If I do the work, he will be the cause." This grandfather was a wealthy merchant and type-founder of Philadelphia, whose happiest days were spent at his easel. It is said his only brother had much artistic talent, though he was an artisan, a painter by trade, with a son who was likewise a painter. This merchant's cousins were artisans, too, with some artistic gifts—one, a jeweler, was also a fine musician and intelligent florist, with a son who became a well-known dramatic manager. Abbey's father was, like his father, a merchant, though inheriting the gift for painting, while his brother was an artist and followed the profession of law.

The Abbeys are described as a race of soldiers, path-finders and pioneer settlers. From their first homes in Connecticut, they pushed up the Connecticut Valley, turning westward with the tide of exploration and settlement through New York, then into Ohio and Michigan and eventually across the continent. Nor were their most illustrious examples of pioneering found in the West. Cleveland Abbe possessed pioneering instinct in abundance with daring imagination, courage and enthusiastic urge in pursuit of a new idea. These abilities conceived and carried to success the multitudinous daily observations on which depend our National Weather Service, which has no parallel in similar undertakings. His brother was known for his original work in the application of radium to medicine, a line which is also followed by his son, while another son is a geographer continuing in the same type of work as his father.

Of the inheritance of mechanical and inventive skill, the Fairbanks and the Pomeroy families have long been known as splendid examples. James Fairbanks married Phoebe Paddock whose two brothers were iron-workers. Erastus Fairbanks, their son, manufactured stoves and plows, while Thaddeus, his brother, invented the platform scales. Erastus married Lois Crosman and had two sons, the elder with much inventive ability and love of natural

history, the younger with a genius for administration, who became Governor of Vermont. Henry, who was a son of Thaddeus, went into the ministry but his love of invention later drew him into manufacturing.

Executive ability, the power of doing things, is also a salient trait in the Pomeroy family. Eltweed, the founder of the family in America was given a grant of 1,000 acres of land by the province of Massachusetts on condition of his establishing his business as gunsmith within its bounds. In each of the seven generations that succeeded him, there has been at least one following the same trade. In this family, the power of doing things easily is frequently carried so far as to exclude the tendency to think about them. The typical Pomeroy is said not to be a good teacher, and the reason as given is that they see through a process so quickly they lose sight of the intermediate steps and thus are unable to explain them to another. If we study their genealogy carefully, we find interesting instances of the coming of this power of abstraction and elucidation in later generations through their marriage into strains such as the Strongs and the Dwights which have this ability in abundance.

Another instance of the inheritance of ability in construction is in the Herreshoff family, designers and builders of the swiftest sailing boats in the world. The first representative in this country was Charles F. Herreshoff who, though an accomplished artist, had little practical business ability. He married Sarah Brown, proficient in music and mathematics, whose family had amassed fortunes in foreign and domestic trade, carrying their goods in ships of their own manufacture. Their son founded the Herreshoff Manufacturing Company and was associated with his three sons, all experts in naval architecture. In none of these examples can we lay the signal success to tradition or merely opportunity, for plenty of their associates have had similar opportunities without once feeling the impulse toward construction of this type.

The history of America gives many illustrations of signal ability in finance extending through three or more generations. We have but to think of the names of Astor, Vanderbilt, Morgan and Rockefeller, Drexel and Palmer, all of whom stand for vast accumulated wealth. It is interesting to reflect what the scions of these houses would have been had they lived in an age which permitted a different type of exploitation, the age of Raleigh and Frobisher. Most of them piled up their riches by conquest of virgin resources, though there are not lacking instances where the chief characteristic was the will and the power to over-ride all competitors. For the most part these American projectors belong to lines of their respective families which show great force and energy, an instinct for contrivance, acquisitiveness, and a spirit of emulation which would brook no opposition to the fulfillment of its schemes. However our captains of industry are not all of the same type, just as they have sprung from stocks whose leading traits have not been by any manner the same. With determination, vitality, and the ability to evaluate correctly situations of all kinds in common, we find in one type love of adventure and exploration, a passion for taking great risks, the traits of the "dead game sport," while in another type, painstaking calculation, careful policy and great economy are the salient characters.

The latter qualities were exemplified to a marked degree in John Jacob Astor, the founder of a line of our most noted financiers. In the sordid confines of a butcher's home in the remote village of Waldorf, we find his childish imagination aflame with legends of marching hosts of Romans, taking their triumphant way along the military road on which the hamlet lay. Later, under the inspiration of letters from America, the vision took the form of possible conquest for himself, so that he spurned the father's trade, and at sixteen, made his way to London and there by arduous unskilled labor earned his passage to America. Here, he was first a peddler of cakes, but with

his first small investment in furs, undertook the hazardous foot and canoe journeys which gave him that knowledge of strategic positions for forts and trading posts which made possible the development of his colossal trading interests. At every step of the way he showed "a persevering industry, a rigid economy and strict integrity. To these were added an inspiring spirit that always looked upward; a genius bold, fertile and expansive; a sagacity, quick to grasp and convert every circumstance to its advantage and a singular and unwavering confidence of signal success." Like energy, optimism and practical sense are said to have distinguished his mother, and she endowed similarly two other sons who signally prospered. John Jacob was the first of a line of which William B., his son, William and John Jacob 3rd, grandsons, and John Jacob 4th and William Waldorf are the most noted.

THE LEAD OF GREAT PERSONALITIES

The study then of these family histories brings into relief lines noted for ability in art, business, mechanical construction and scientific investigation, with the frequent occurrence of members who have achieved renown in the various lines. These leaders pos-

GENETIC CLASSIFICATION OF AMERICAN STRAINS

Aristogenic, Through segregation in superior stocks, producing trait-complexes of high excellence.

I. Superlative worth.
1. Jurisprudence—eg: Kent, Story, Marshall
2. Statecraft—eg: Adams, Lowell, Livingston
3. Metaphysics—eg: Edwards, Woolsey
4. Education—eg: Mann, Dwight, Edwards
5. Social Reform—eg: Beecher, Abbott
6. Religion—eg: Ballou, Channing
7. Military Leadership—eg: Washington, Lee
8. Oratory—eg: Choate, Webster
9. Literary Expression—eg: Prescott, Irving
10. Histrionic Art—eg: Booth, Sothern
11. Poetry—eg: Bryant, Longfellow
12. Graphic Arts—eg: Abbey, Inman
13. Music—eg: Hutchinson, Buck
14. Natural Science—eg: Agassiz, Baird
15. Mathematical Sciences—eg: Newcomb, Pickering
16. Invention—eg: Morse, Bell
17. Politics—eg: Hamilton, Randolph
18. Pioneer Life—eg: Boone, Sinclair
19. Engineering—eg: Pomeroy, Herreshoff
20. Exploration—eg: Peary, Greeley
21. Finance—eg: Astor, Girard, Morgan

II. Superior worth.
Special skill, intelligence, enterprise, etc.
Names occurring in "Who's Who in America."

Eugenic, Through segregation, contributing to classes of superior as well as those of inferior worth.

III. Mediate social worth.
Showing a great range of aptitudes and abilities in moderate degree.
The so-called middle class, making up the run of mechanics, small farmers and trades-people, clerks, operators, general laborers, etc.

Cacogenic, Through segregation, producing recessive trait-complexes.

IV. Low social worth.
Marked psychical or temperamental defects.
1. Feeble-minded
2. Pauperous
3. Neuropathic
4. Criminalistic
5. Insane
6. Sex Perverts
7. Crippled
8. Psychopathic

The "Jukes," "Kallikaks," "Ishmaelites."

This classification is intended to be mainly suggestive. The classes are not sharply delimited from one another, and the examples given for superlative worth are not necessarily of uniform value. They are such as would occur to the reader and serve to illustrate how certain lines of a given family name may come to bear a more or less distinctive character, depending primarily on fortunate trait-complexes and secondarily on the environal influence known under the term "social heritage."

sessed in marked degree the daring pioneer spirit, which, exemplified to a lesser extent in so many of our countrymen, has made the epic of conquest of the continent.

What a story it has been, of fortitude and sacrifice and of courage surpassing that of a soldier! We should fitly celebrate this struggle with the wilderness, with scorching heat and biting cold, with flood and drought and fire. We should be grateful for the planting here of those families fitted to cope with adverse circumstance and turn mischance to victory, and for the best from many racial strains who followed acceptably where the greater personalities led. This is the story of "Americanization" on its material side, though to it have been brought many of the finest qualities with which man is endowed. From one point of view, it is the story of chosen germ-plasms, that should lead every one who can even remotely appreciate it, to resolve that so far as possible his family shall be one of the chosen to lead further on the path of progress.

HEREDITARY TRADES

THE agricultural population of Italy furnishes a rather interesting example of the preservation of tribal occupational distinctions. For centuries the people of the Burino, Ciocare, Rieti, Abruzzi, or Ortanesi have followed their individual vocations of reapers, diggers, sowers, vine-trimmers, etc., in the fever-swept marshes of the Roman Campagna, and the names of these families who worked in the fertile though deadly plains have been adapted, in the common parlance of the agricultural world of Italy, to mean any follower of that trade. So identified with the art of seed-planting are, for example, the Rieti, that sowers throughout Italy are called "Rieti," regardless of their origin, and the threshers are known popularly as "Ciocare."

The really remarkable fact concerning the fidelity of each of these races to its vocation is that this adherence to tradition continues despite the unhealthy character of the region in which they have so long operated. They suffer no delusion as to the danger of working in the marshes, but the fertility of the soil, fr m which may be garnered three crops yearly—grain, grapes, and charcoal—has kept generation after generation following in the footsteps of the preceding one. Few breaks from the lineal tradition have taken place. The terrible death-rate in the community has orphaned hundreds of children, and the orphanages with industrial schools and agricultural colonies, which the Junior Red Cross of America has founded at Piperno and Sezze, are filled largely with these children, still known by their racial cognomen, as "children of the reapers, vine-trimmers, etc."

These agricultural workers do not remain in the region throughout the year. As the season fitted to the occupation of each comes around, each community gathers together its goods and implements and migrates to the malarial marshes of the coastal plain. First to come in the spring are the Abruzzi, tillers of the soil from Aquila in the mountains above Rome, next follow the Rieti, sowers from the Sabine mountains, the reapers of the Burino race from the Lapini hills above the marshes, and then the threshers who still wear the heavy sandal-like shoes which aid their leathern flails in threshing out the grain.

Interesting and picturesque though these farmers may be from the viewpoint of heredity, they do not satisfy the laws of modern hygiene in their choice of territory. Many of the children of these races are now being taught trades in the Piperno and Sezze schools, which will doubtless take them away from the unhealthy plains, and the fate of the remainder depends largely upon the results of an Italian engineering project, now on foot, which should succeed in making of the plague-ridden marshes a far more healthful neighborhood. A photograph of Italian orphans pruning vines is shown on the following page.

ITALIAN ORPHANS PRUNING VINES ACCORDING TO THE METHODS OF THEIR FOREFATHERS

These boys from one of the agricultural colonies directed by the Junior Red Cross in Italy are trimming the vines according to the rules followed by former generations. They are twining the young vines over an elaborate scaffolding of twigs on the ash and poplar trees until the vines can climb by themselves. Photograph from the American Red Cross. (Fig. 17.)

INHERITANCE IN CROSSES OF DAIRY AND BEEF BREEDS OF CATTLE

III. Transmission of Butter-Fat Percentage to the First Generation[1]

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THE inheritance of *milk yield* in the first generation crosses of dairy and beef breeds of cattle was treated in the second paper of this series.[2] The inheritance of butterfat percentage for the same crosses will be analyzed here.

Butter-fat percentage has been shown to have a considerable variation with age in the Ayrshire breed, some relation to age in the Jersey and Guernsey breeds and no significant relation to age in the Holstein-Friesian breed. These relations necessitate the application of age correction factors to the Jersey, Guernsey and Ayrshire records for butter-fat percentage to make these records comparable. Without any previous knowledge as to how age will effect the butter-fat percentage of the crosses between these breeds, it has been thought advisable to correct the crossbred records with the same set of correction factors which were used for the Jersey and Guernsey. When a butter-fat percentage record is mentioned in any subsequent section of this paper it is to be understood that it is an age corrected record.

HOW THE RECORDS ARE OBTAINED

The butter-fat percentage record for any given crossbred cow or her dam is obtained by taking the mean butter-fat percentage of the different lactations during the cow's life at the same corresponding month of lactation. The butter-fat percentage of the sires, Taurus Creamelle Hengerveld and Lakeland's Poet, are the mean of the butter-fat percentage of their daughters other than crossbred daughters. The record of Kayan, where no pure bred daughters are available, is obtained by averaging the records of the Aberdeen-Angus cows in the herd. The record for Delva's University DeKol is the record of Taurus Creamelle Hengerveld. The records of the last two sires are subject to the same criticisms cited in the second paper of the series.

The details of the number of lactations which make up the record of the given cow are given in the second paper of this series and need not be repeated here.

BUTTER-FAT PERCENTAGES

The first graph in Figure 24 shows the monthly butter-fat percentage of Crossbred No. 1, her pure bred Holstein-Friesian dam, Pauline Posch and the potential record of her Jersey sire, Lakeland's Poet. Photographs showing Crossbred No. 1 and her parents are shown in the previous paper of this series. The solid line (————————) represents the crossbred's butter-fat percentage, the dotted line(. . . . . .) the butter-fat percentage of her dam and the dot and dash line (·—·—·—·) the potential butter-fat percentage of her sire. The butter-fat percentage of this crossbred is clearly intermediate between that of her high butter-fat test sire and her low butter-fat percentage dam. The eight months' butter-fat percentage for Crossbred No. 1 was 3.899. The butter-fat percentage for her Holstein-Friesian dam was 2.758 and for her Jersey sire was 4.705. The crossbred cow was consequently 0.806 per cent less than her Jersey parent and 1.141 per cent more than her low testing Holstein-Friesian parent. The

[1] Papers from the Biological Laboratory of the Maine Agricultural Experiment Station, No. 136.

[2] Gowen, John W., 1920. Inheritance in Crosses of Dairy and Beef Breeds of Cattle. II. On the Transmission of Milk Yield to the First Generation. JOURNAL OF HEREDITY, Vol. XI (1920), No. 7, pp. 300-316.

Crossbred No. 1 is consequently nearer the high test parent than the low test parent. It is perhaps fair in this connection to say that the butter-fat percentage of Pauline Posch is low even for the Holstein-Friesian breed, the mean for the breed being nearly .5 per cent higher than her average.

Crossbred No. 2 has her butter-fat percentage shown in the second graph in Figure 24. She is the result of a cross of the Holstein-Friesian sire, Delva's University De Kol, to the Guernsey cow, Canada's Creusa. The photograph of Crossbred No. 2 is shown in Fig. 18. The characteristics of the Holstein-Friesian parent are seen in the rump, the size of body and the profile of the nose.

The butter-fat percentage of this crossbred clearly resembles that of her low testing Holstein-Friesian parent. The average butter-fat percentage of Crossbred No. 2 for the eight months' period was 3.241. The average butter-fat percentage for her Guernsey dam, Canada's Creusa, was 3.961,[3] and for the potential butter-fat test of her Holstein-Friesian sire, Delva's University DeKol was 3.399. The butter-fat percentage of the crossbred cow is consequently slightly less than that for either parent. The difference from her Guernsey parent is 0.720 per cent and from her Holstein-Friesian parent 0.158 per cent. Crossbred No. 2 resembles the low butter-fat percentage 4.5 times as closely as she does the high butter-fat percentage.

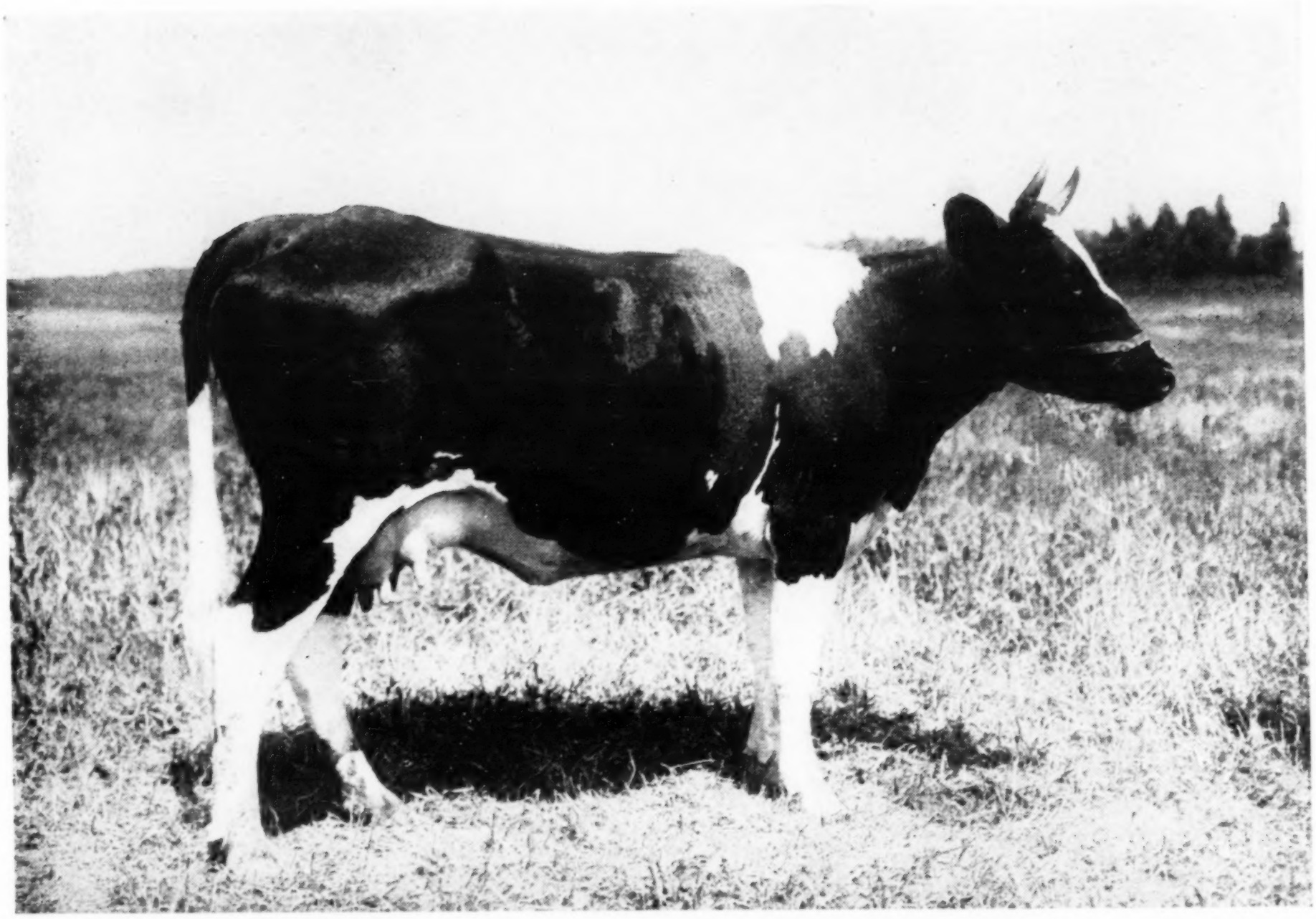
The third graph in Figure 24 represents the butter-fat percentage of the Crossbred No. 11 and that of her pure bred Jersey sire, Lakeland's Poet, and her pure bred Holstein-Friesian dam, Delva Johanna DeKol.

Photographs of the animals used in this mating are shown in Figs. 19, 20 and 21. The dark underline and fair Jersey conformation of Lakeland's Poet are clearly seen. Delva Johanna DeKol shows the typical conformation of her body and udder. Crossbred No. 11 has an appearance of size in the fore quarters and a lack of these qualities in the hind quarters which is due largely to the position in which she is standing.

While the butter-fat percentage of Crossbred No. 11 is intermediate between that of her high testing and her low testing parents throughout the entire lactation, it is equally clear that the butter-fat percentage of the cross is much nearer that of her low testing parent than it is to that of the high testing parent. The mean butter-fat percentage of Crossbred No. 11 for the eight months' period is 3.403, that for the Holstein-Friesian dam 3.224, the potential butter-fat percentage for the Jersey sire is 4.705. The difference between the low testing dam and the crossbred cow is consequently 0.179. The difference between the crossbred and her high testing sire is 1.302, or Crossbred No. 11 resembles the butter-fat percentage of the low testing parent 7.3 times as closely as she does the butter-fat percentage of the high testing parent.

The butter-fat percentage of Crossbred No. 12 and her Guernsey dam, College Gem, together with the potential butter-fat percentage of her Holstein-Friesian sire is shown in the fourth graph of Figure. 24. Photographs of the animals composing this mating are shown in the previous paper of this series. The butter-fat percentage of College Gem, the mother to this crossbred cow, and that of Creusa's Lady, the dam of Crossbred No. 29, is considerably higher than that of other animals used in these crosses. A study of the butter-fat percentage of the breed to which these cows belong and also of the Jersey breed makes it appear quite possible that there are at least two levels of butter-fat percentage, speaking from the inheritance viewpoint, within these breeds. Should such prove to be the case the results of the crosses including these relatively high butter-fat testers might produce a different result than those including the lower testing cows.

[3] The butter-fat percentage for Canada's Creusa is clearly very low for a Guernsey cow. In the advanced registry of this breed the average year test is 4.9 per cent of butter-fat.



CROSSBRED NO. 2, HOLSTEIN-FRIESIAN X GUERNSEY CROSS

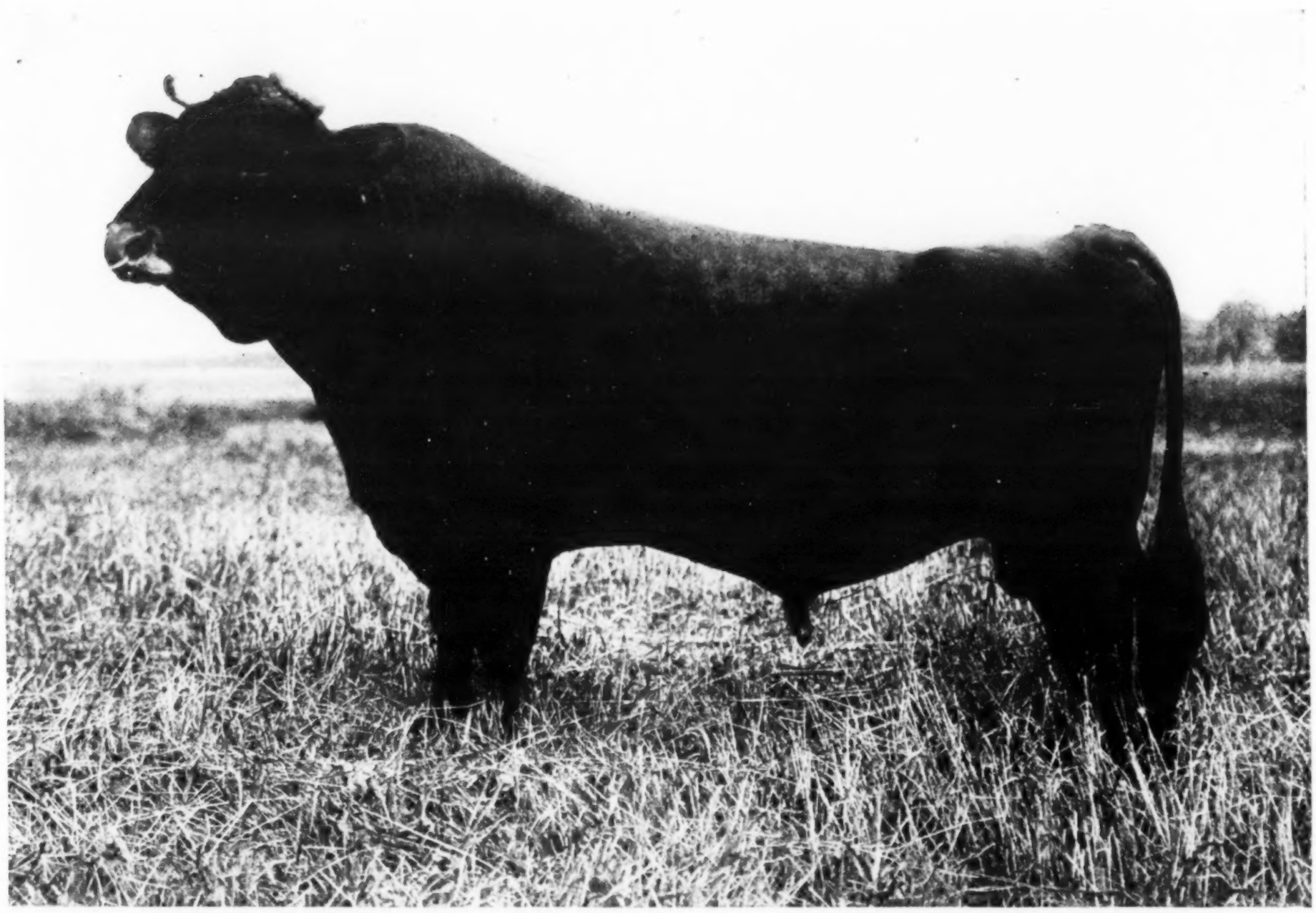
In size of body and profile of nose this crossbred shows the characteristics of her Holstein-Friesian sire. Her percentage of butter fat production is slightly lower than that of either parent. See the second graph in Fig. 24. (Fig. 18.)

The graph for the butter-fat percentage of Crossbred No. 12 shows it to be intermediate between the high testing and the low testing parents. The low testing parent is more closely followed by the Crossbred for each monthly test. The eight months butter-fat percentage of Crossbred No. 12 is 3.885 per cent, the Guernsey dam has a butter-fat percentage of 5.476 per cent and the Holstein-Friesian sire's potential butter-fat percentage is 3.399 per cent. The crossbred cow's butter-fat per cent is 1.591 per cent less than her high testing dam and 0.486 per cent more than her low testing parent, or the crossbred is 3.3 times as near the low butter-fat percentage as she is the high butter-fat percentage.

BUTTER-FAT PERCENTAGES OF SIMILAR MATINGS

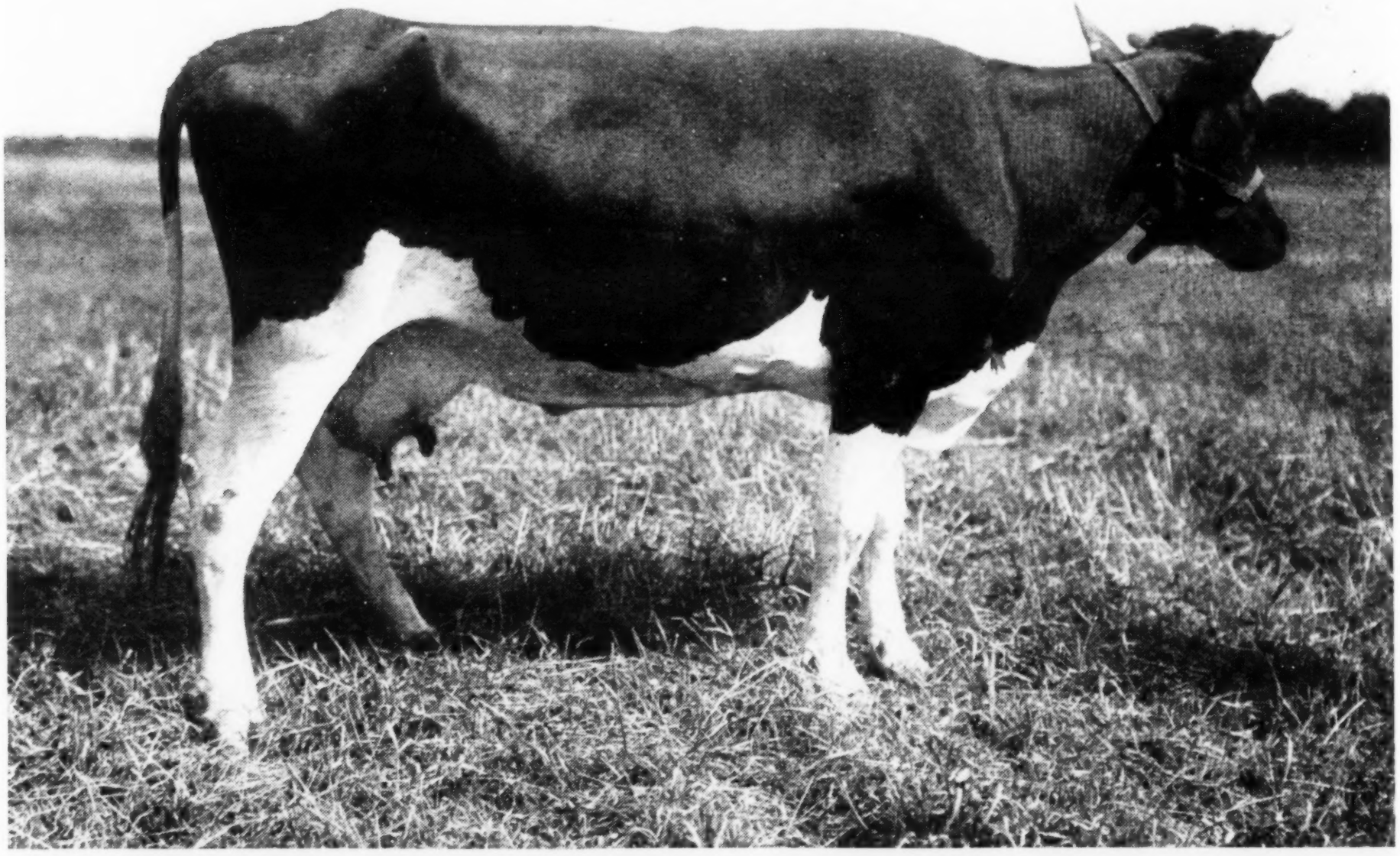
It is of some interest to compare the butter-fat percentage of the similar mating for Crossbred No. 2 with the results for this mating of Crossbred No. 12. The Guernsey dam in the first case had a very low butter-fat percentage 3.961 whereas the Guernsey dam for number 12 had a butter-fat percentage which is above the average for the breed. The butter-fat percentage of the Crossbred in the first case was low, lower even than the Holstein-Friesian parent. The butter-fat percentage of the Crossbred in the second case was higher, almost equaling that of the low testing Guernsey dam of the first cross.

The Aberdeen-Angus breed has a butter-fat percentage about the same as that of the lower testing Jerseys and Guernseys of these experiments, that is a mean of about 4.4 per cent with considerable range on either side of this point. The crosses made between these lower testing Jerseys and Guernseys with the Aberdeen-Angus are con-



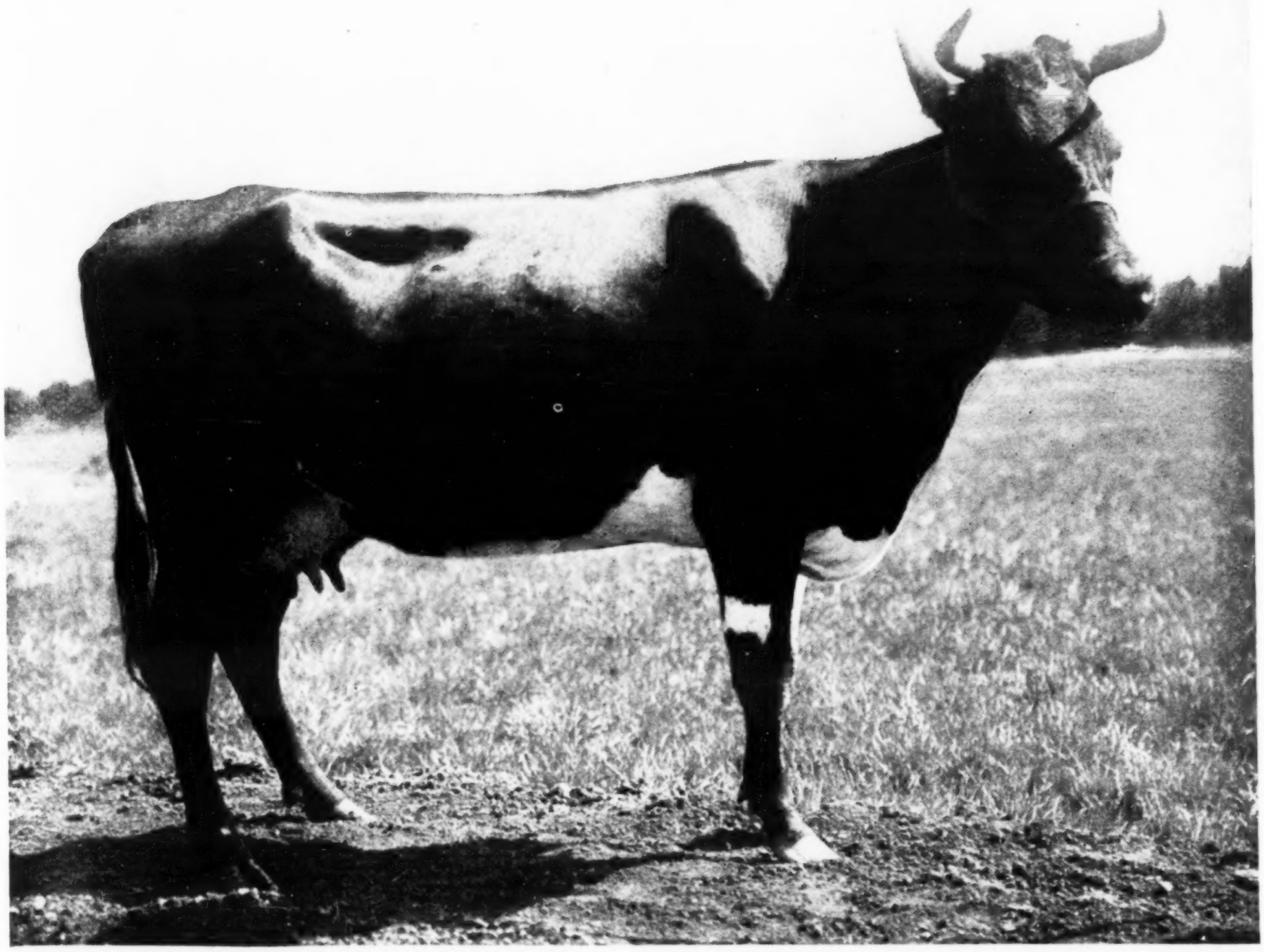
LAKELAND'S POET, PUREBRED JERSEY SIRE OF CROSSBRED NO. 11

Note the dark underline and fair Jersey conformation. Lakeland's Poet is also the sire of Crossbred No. 15 shown in Fig. 23. (Fig. 19.)



DELVA JOHANNA DE KOL, PUREBRED HOLSTEIN-FRIESIAN DAM OF CROSSBRED NO. 11

The typical Holstein-Friesian conformation of body and udder is clearly represented. (Fig. 20.)



CROSSBRED COW NO. 11

This cow is the product of the Jersey and Holstein-Friesian parents shown on the opposite page. The appearance of size in the fore quarters and lack of it in the hind quarters is largely due to the position in which she is standing. The size and shape of her udder, conformation and other features, are quite well represented. The third graph in Fig. 24 shows the butter-fat percentage of this crossbred to be almost intermediate between her high-testing and low-testing parents. (Fig. 21.)

sequently of little interest. They are included in the graphs for sake of completeness.

The fifth graph in Figure 24 shows the butter-fat percentage for Crossbred No. 15 and her Aberdeen-Angus dam, Hearthbloom, and Jersey sire, Lakeland's Poet. Very little difference is seen in the butter-fat percentages of these animals. The eight months butter-fat percentage for Crossbred No. 15 is 4.404; for her dam Hearthbloom 4.404 and for her Jersey sire 4.705. Crossbred No. 15 agrees exactly with her lower testing parent and is .301 per cent less than the higher testing parent.

Figures 22 and 23 represent Crossbred No. 15 and her Aberdeen-Angus dam. The heavy, blocky, well filled conformation of Hearthbloom is typical of the Aberdeen-Angus breed. There are many points of resemblance between Crossbred No. 15 and her dam.

The sixth graph for Figure 24 shows the butter-fat percentage for Crossbred No. 16, her Jersey dam College Ruth and her Aberdeen-Angus sire, Kayan. The photographs of the animals composing these matings are shown in the previous paper of this series. Little difference between the butter-fat percentages for the three animals is noted. For the first eight months of lactation the butter-fat percentage of Crossbred No. 16 is 4.894, for College Ruth 4.849 and for Kayan 4.386. The crossbred

cow is consequently 0.045 higher in butter-fat percentage than her dam and 0.508 per cent higher than her sire.

The top graph in Figure 25 represents the butter-fat percentage of Crossbred No. 22, her Guernsey dam, College Creusa and her Aberdeen-Angus sire, Kayan. As explained in the previous paper, the graphs in Figure 25 are less reliable than those of Figure 24, since they are composed of a less number of lactations for the crossbred cows. Little difference in the butter-fat percentages of these three animals are shown by the graphs. The eight months butter-fat percentage of Crossbred No. 22 was 4.526, the butter-fat percentage of her Guernsey dam 4.825 and of her Aberdeen-Angus sire 4.386. Crossbred No. 22 is 0.299 per cent of butter-fat less than her dam and 0.140 per cent more than her sire.

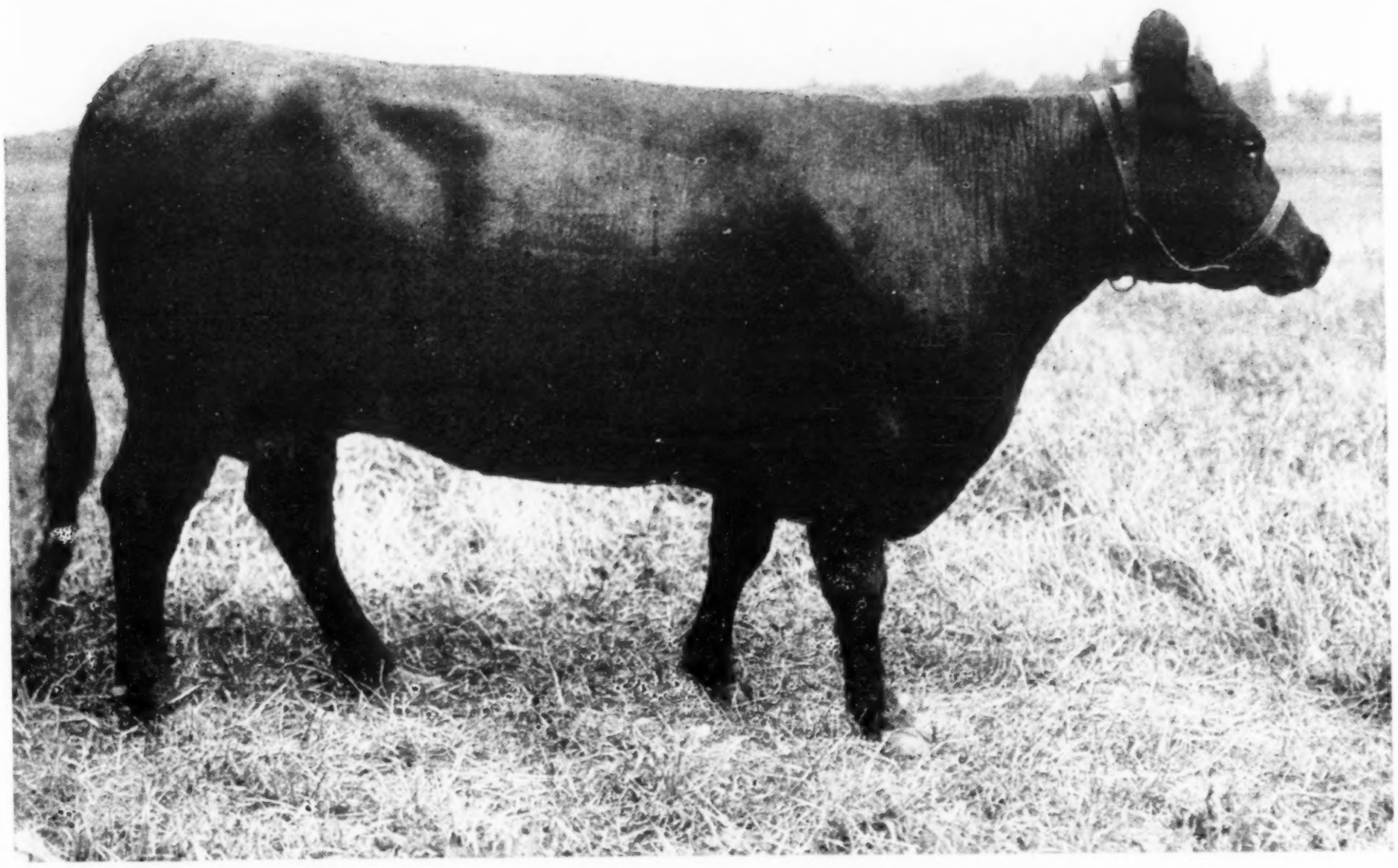
The butter-fat percentages of Crossbred No. 26 and her parents, Creusa of Orono 3d, Guernsey dam, and Kayan, Aberdeen-Angus sire, are shown in the second graph in Figure 25. Little difference in the monthly butter-fat percentage of the three animals is seen in the graphs. The mean eight months butter-fat percentage of Crossbred No. 26 is 4.100, that for the Guernsey dam 4.679 and for the Aberdeen-Angus sire 4.386. Crossbred No. 26 has 0.579 per cent of butter-fat less than her dam and 0.286 per cent less than her sire's potential butter-fat percentage.

The butter-fat percentage of Crossbred No. 27 is seen to vary irregularly over that of her two parents in the third graph of Figure 25. Crossbred No. 27 is the result of a cross between Orono Madge, Aberdeen-Angus cow, and Lakeland's Poet, Jersey bull. The average butter-fat percentage of Crossbred No. 27 is 4.474, of her Aberdeen-Angus dam's 4.640, and of her Jersey sire 4.705. Crossbred No. 27 was 0.166 per cent of butter-fat less than her dam and 0.231 per cent of butter-fat less than her sire.

While Crossbred No. 29 is the result of a cross between Creusa's Lady, Guernsey dam and Kayan, Aberdeen-Angus sire, she is of some interest, since her dam, Creusa's Lady, is one of the higher butter-fat testing Guernsey cows. The fourth graph in Figure 25 shows the monthly butter-fat percentage for this mating. For the first month the butter-fat percentage of the crossbred is higher than that of either parent. After this time her butter-fat percentage follows the butter-fat percentage of the relatively lower testing Aberdeen-Angus parent. The mean butter-fat percentage for the eight months period is 4.534 per cent for the crossbred cow, 5.346 for her pure bred dam and 4.386 per cent for her sire. The crossbred is 0.812 per cent less in her butter-fat test than her dam and 0.148 per cent more than her sire. The crossbred cow resembles her low testing parent 5.5 times as closely as she does her high testing parent.

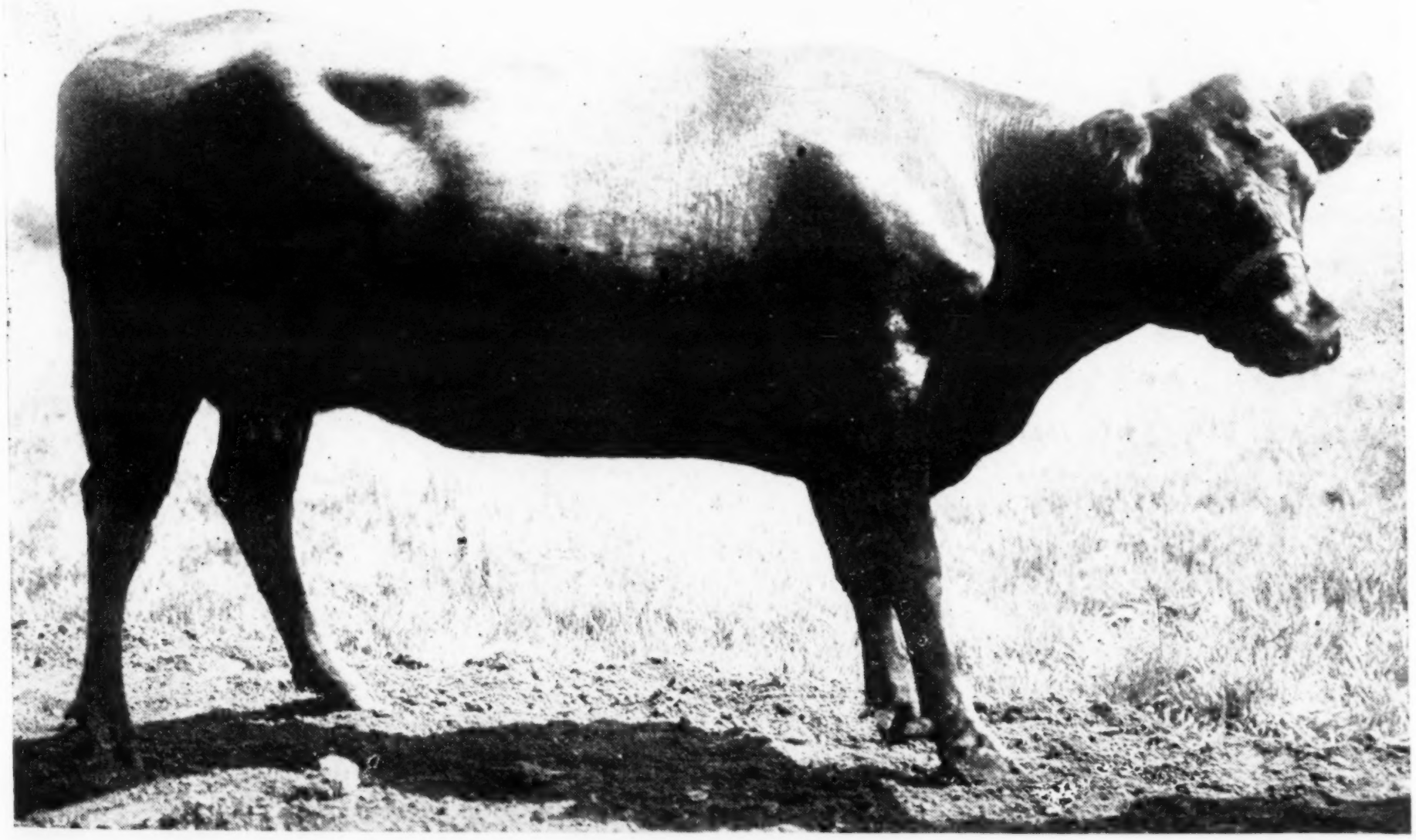
The average butter-fat percentage of the Ayrshire breed is 3.68 per cent. This is about 1.0 per cent below the butter-fat percentage of the Aberdeen-Angus contained in this herd, and only 0.4 per cent above the average of the Holstein-Friesian breed. Crossbred No. 37 is the result of a cross between the Ayrshire cow, Dot Alaska and the Aberdeen-Angus sire, Kayan. The fifth graph of Figure 25 gives the butter-fat percentage of Crossbred No. 37 and her parents. The crossbred's record is for only one complete lactation and one half of the next. Considerable variation would consequently be expected for this record. In the fifth month of lactation the butter-fat percentage of Crossbred No. 37 is slightly higher than that for the high testing parent, Kayan. Other than this record the butter-fat percentage of the crossbred closely approximates that for the lower testing parent, Dot Alaska. The eight months butter-fat percentage for Crossbred No. 37 was 3.861 per cent, for Dot Alaska was 3.661 per cent and for Kayan 4.386 per cent. Crossbred No. 37 is 0.200 per cent more in her butter-fat percentage than that of her dam, and 0.525 per cent less than her Aberdeen-Angus sire or the ratio is 1 to 2.6.

The last graph in Figure 25 is that for Crossbred No. 44. Crossbred No. 44



HEARTHBLOOM, ABERDEEN-ANGUS PARENT OF CROSSBRED NO. 15

The heavy, blocky, well-filled conformation of this cow is typical of her breed. (Fig. 22.)



CROSSBRED COW NO. 15

There are many points of resemblance between this crossbred and her purebred Aberdeen-Angus mother, the polled head, heavy fore quarters and black coat being the main features. The 5th graph in Fig. 24 shows that her butter-fat percentage was exactly the same as the record of her mother. The sire of this crossbred is Lakeland's Poet shown in Fig. 19. (Fig. 23.)

cow is consequently 0.045 higher in butter-fat percentage than her dam and 0.508 per cent higher than her sire.

The top graph in Figure 25 represents the butter-fat percentage of Crossbred No. 22, her Guernsey dam, College Creusa and her Aberdeen-Angus sire, Kayan. As explained in the previous paper, the graphs in Figure 25 are less reliable than those of Figure 24, since they are composed of a less number of lactations for the crossbred cows. Little difference in the butter-fat percentages of these three animals are shown by the graphs. The eight months butter-fat percentage of Crossbred No. 22 was 4.526, the butter-fat percentage of her Guernsey dam 4.825 and of her Aberdeen-Angus sire 4.386. Crossbred No. 22 is 0.299 per cent of butter-fat less than her dam and 0.140 per cent more than her sire.

The butter-fat percentages of Crossbred No. 26 and her parents, Creusa of Orono 3d, Guernsey dam, and Kayan, Aberdeen-Angus sire, are shown in the second graph in Figure 25. Little difference in the monthly butter-fat percentage of the three animals is seen in the graphs. The mean eight months butter-fat percentage of Crossbred No. 26 is 4.100, that for the Guernsey dam 4.679 and for the Aberdeen-Angus sire 4.386. Crossbred No. 26 has 0.579 per cent of butter-fat less than her dam and 0.286 per cent less than her sire's potential butter-fat percentage.

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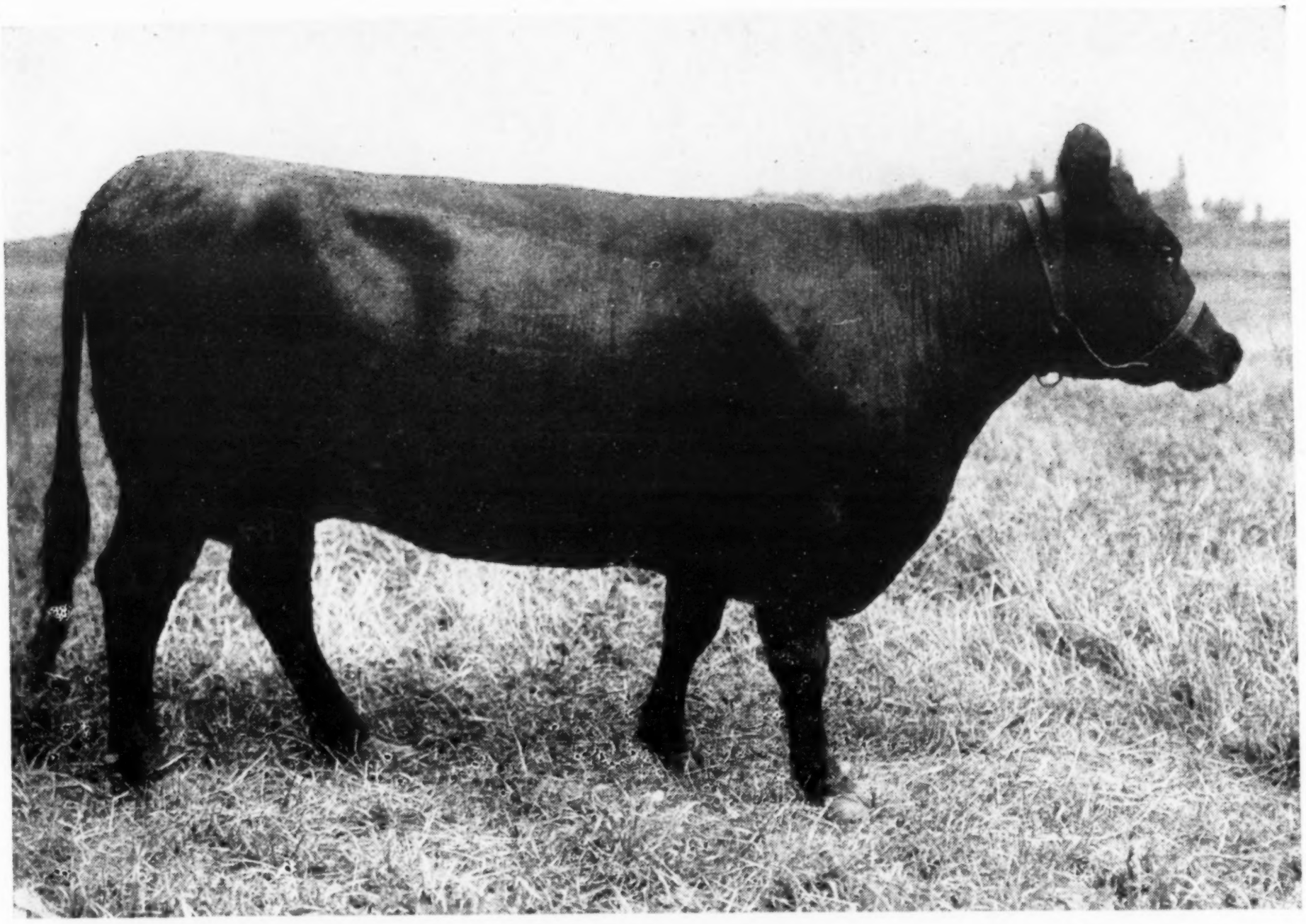
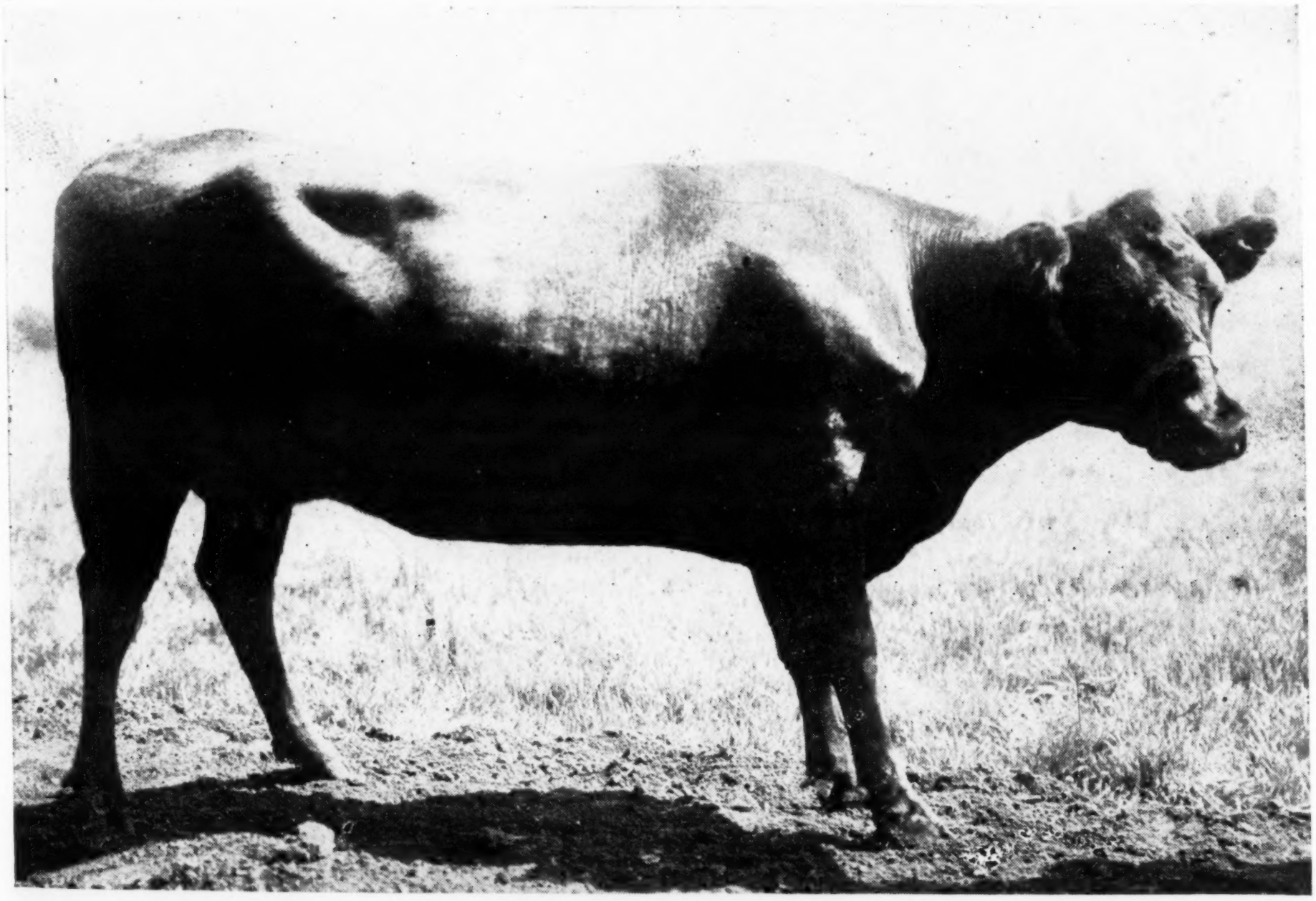
The average butter-fat percentage of the Ayrshire breed is 3.68 per cent. This is about 1.0 per cent below the butter-fat percentage of the Aberdeen-Angus contained in this herd, and only 0.4 per cent above the average of the Holstein-Friesian breed. Crossbred No. 37 is the result of a cross between the Ayrshire cow, Dot Alaska and the Aberdeen-Angus sire, Kayan. The fifth graph of Figure 25 gives the butter-fat percentage of Crossbred No. 37 and her parents. The crossbred's record is for only one complete lactation and one half of the next. Considerable variation would consequently be expected for this record. In the fifth month of lactation the butter-fat percentage of Crossbred No. 37 is slightly higher than that for the high testing parent, Kayan. Other than this record the butter-fat percentage of the crossbred closely approximates that for the lower testing parent, Dot Alaska. The eight months butter-fat percentage for Crossbred No. 37 was 3.861 per cent, for Dot Alaska was 3.661 per cent and for Kayan 4.386 per cent. Crossbred No. 37 is 0.200 per cent more in her butter-fat percentage than that of her dam, and 0.525 per cent less than her Aberdeen-Angus sire or the ratio is 1 to 2.6.

The last graph in Figure 25 is that for Crossbred No. 44. Crossbred No. 44



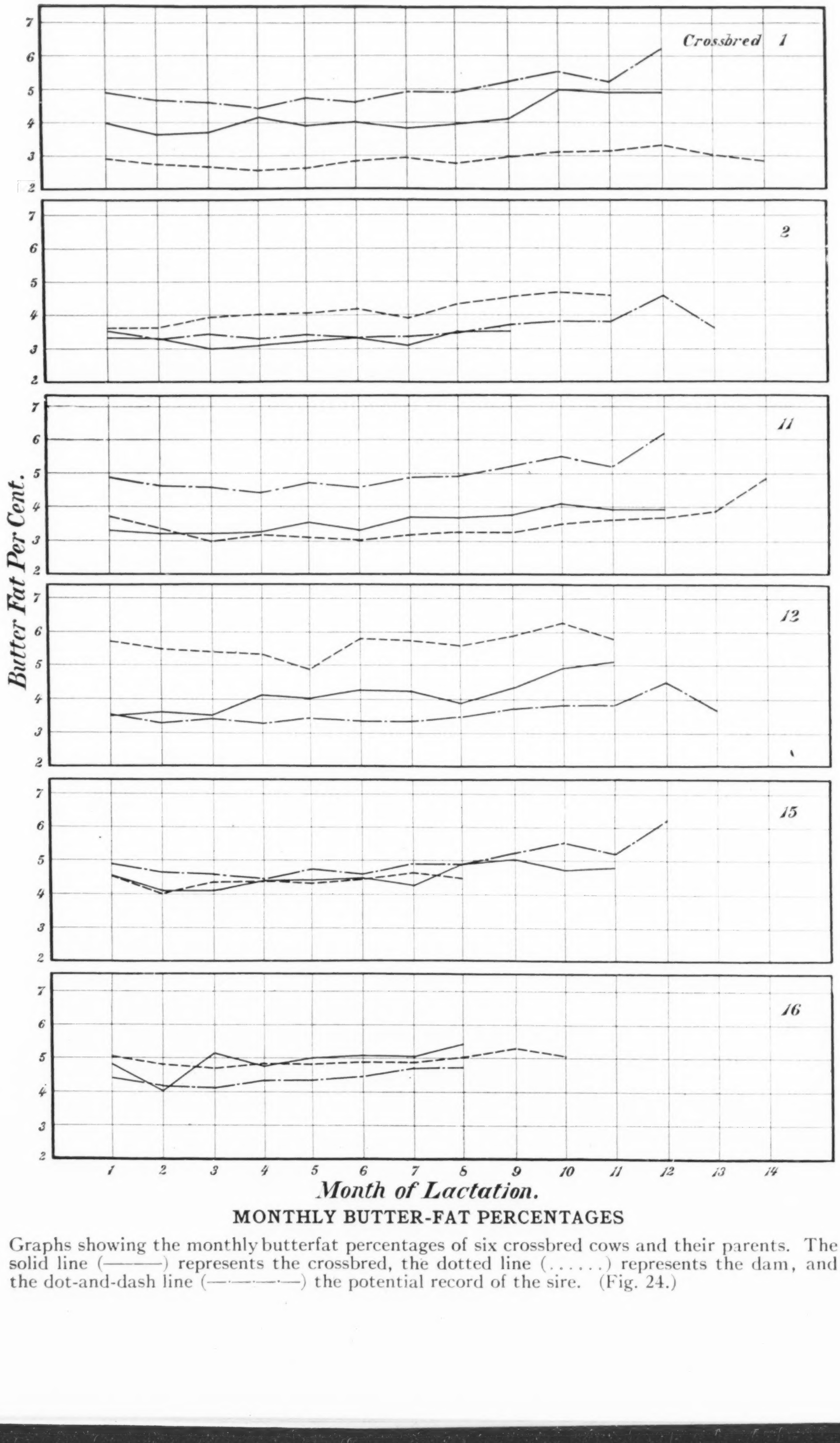
HEARTHBLOOM, ABERDEEN-ANGUS PARENT OF CROSSBRED NO. 15

The heavy, blocky, well-filled conformation of this cow is typical of her breed. (Fig. 22.)



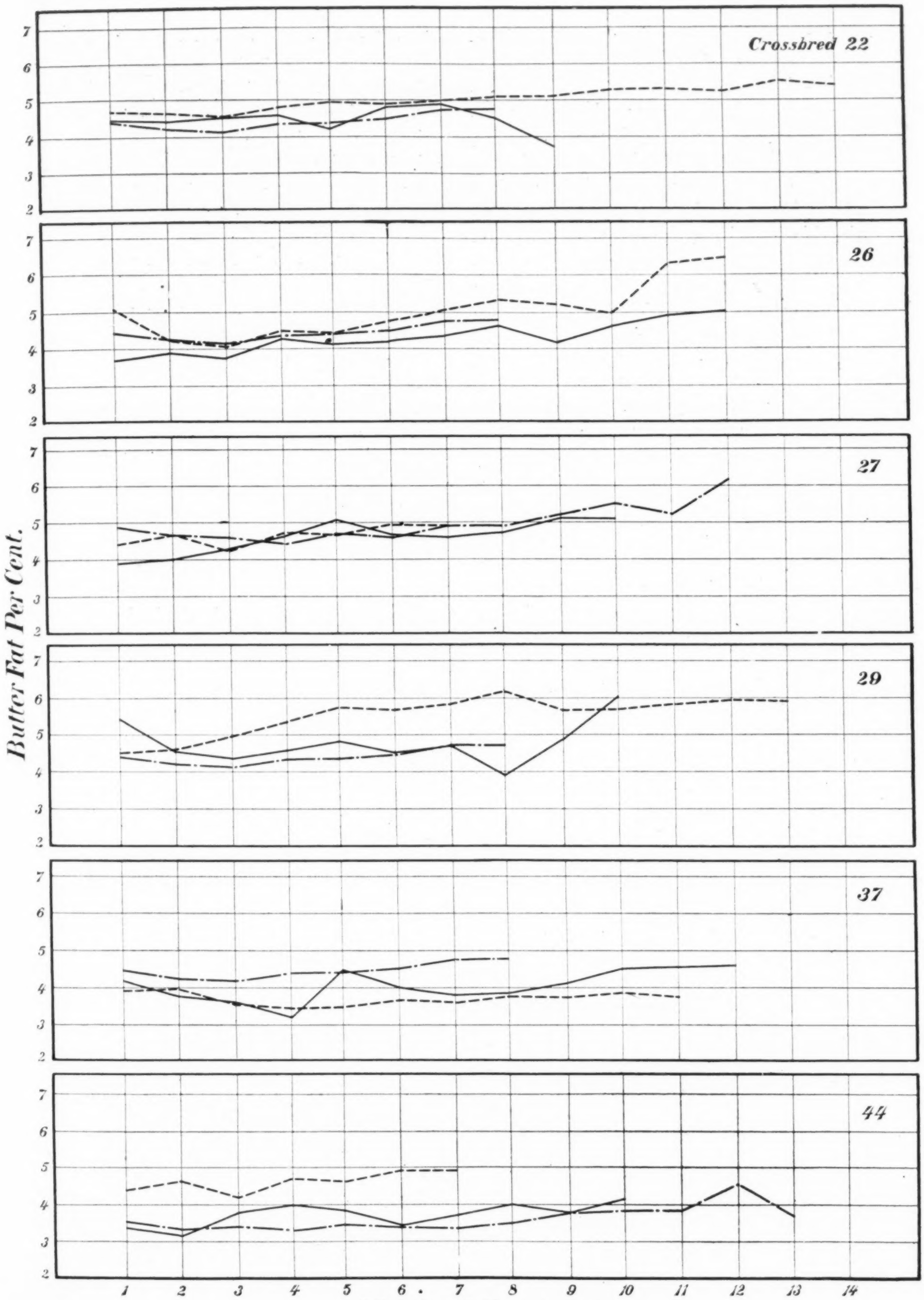
CROSSBRED COW NO. 15

There are many points of resemblance between this crossbred and her purebred Aberdeen-Angus mother, the polled head, heavy fore quarters and black coat being the main features. The 5th graph in Fig. 24 shows that her butter-fat percentage was exactly the same as the record of her mother. The sire of this crossbred is Lakeland's Poet shown in Fig. 19. (Fig. 23.)



MONTHLY BUTTER-FAT PERCENTAGES

Graphs showing the monthly butterfat percentages of six crossbred cows and their parents. The solid line (———) represents the crossbred, the dotted line (. . . . .) represents the dam, and the dot-and-dash line (—·—·—·—) the potential record of the sire. (Fig. 24.)



MONTHLY BUTTER-FAT PERCENTAGES

Graphs showing monthly butter-fat percentages of crossbred cows and their parents. The significance of the lines is the same as in Fig. 24 on the opposite page. (Fig. 25.)

is the result of the mating of the Aberdeen-Angus cow Orono Madge to the Holstein-Friesian bull Taurus Creamelle Hengerveld. The graph for Crossbred No. 44 shows that her butter-fat percentage for her first lactation is intermediate between that of her high and her low testing parents at the fourth, fifth and sixth months of lactation. Other than these months the crossbred cow clearly follows the low butter-fat percentage of her low testing sire. The eight months mean butter-fat percentage for Crossbred No. 44 was 3.656 per cent, that for her Aberdeen-Angus dam 4.640 per cent, and for her Holstein-Friesian sire 3.399 per cent. The crossbred cow was consequently 0.984 per cent less in her butter-fat percentage than her high testing dam and 0.257 per cent more than her low testing sire. The crossbred cow consequently is 3.8 times as near to the low butter-fat percentage as she is to the higher butter-fat percentage line.

These observations may be regrouped to show the changes brought about in the butter-fat percentage of the offspring in accordance with the way the cross was made. For those crosses in which the Holstein-Friesian sire was used, the offspring in all cases resembled the low testing sire between 3.3 and 4.5 to 1 as closely as they did the high testing parent, the mean being 3.9 to 1. For those crosses in which the dam was of the Holstein-Friesian breed, the results of the offspring were contradictory, one approaching the butter-fat percentage of the high test parent 1.4 to 1 and the other approaching the butter-fat test of the low Holstein-Friesian cow 7.3 to 1. The cross involving the Ayrshire dam resembled the low test 2.6 to 1. The high test Guernsey dam when crossed to the lower test Aberdeen-Angus sire had a daughter which resembled the low testing sire 5.5 times as closely as she did the high testing dam.

Considering every cross irrespective of their merit for this particular phase of the work the crosses resemble the low testing parental breed 2.23 times as closely as they do the high testing parental breed.

Several experiments undertaken by the breeders cited in the previous papers furnish data which incidentally bear on the inheritance of butter-fat percentage. The butter-fat tests given by Parlour, Kuhlman, and Strevens[4] for the F_1 cows from crosses of the Jersey and Aberdeen-Angus breeds show that the F_1 differs little from either parent. This as indicated in a previous section of this paper would be expected since the Jersey and Aberdeen-Angus breeds have quite similar butter-fat tests.

In crossing Holstein-Friesian bulls to several scrub cows of rather high butter-fat test Kildee and McCandlish's[5] results show that the butter-fat percentage for the F_1 cows is intermediate between the two parents approaching if anything the butter-fat percentage of the lower testing Holstein-Friesian sires. The F_1 crosses of the Guernsey and Jersey sires to the scrubs show a slight improvement of the butter-fat percentage over that of their dams. The results for the Jersey and Guernsey crosses are of no particular importance to the discussion since the butter-fat tests of the animals crossed was nearly the same. The F_1 crosses for the Holstein-Friesian sires and scrub cows are of interest and agree quite closely with the results of the controlled experiment herein described considering that more than one sire may have been used, that age corrections were not made and that the progeny

[4] Parlour, W.
1913. Jersey Angus Cattle. Live Stock Jour. (London) 77 (1913) No. 2025 p. 85.
Kuhlman, A. H.
1915. Jersey-Angus Cattle. JOURNAL HEREDITY 6 (1915) No. 2, pp. 68–72.
Strevens, H. D. E.
1913. Jersey-Angus Cattle. Live Stock Jour. (London) 77 (1913) No. 2025, p. 132.

[5] Kildee, H. H. and McCandlish, A. C.
1916. Influence of Environment and Breeding in Increasing Dairy Production. Bul. 165. Iowa Agri. Expt. Sta., pp. 383–402.

performance test of the sires is not known.

Dunne[6] quotes some Danish records to show that there are two types of cows in the red Danish breed. One of these types tests about 3.3 per cent. The other type tests about 4.00 with the cross between the two having a butter-fat percentage which is intermediate. These results are however open to considerable criticism when viewed as critical evidence. The results cannot therefore be accepted as proof.

Castle[7] records an experiment commenced by Mr. Bowlker on crosses between the Guernsey and Holstein-Friesian breeds. Unfortunately only a very limited number of tests on the original pure bred cows were made. It is necessary therefore to use the average butter-fat percentages of the breeds as the parents test for butter-fat. Such a procedure is open to error in that the breeds' average butter-fat concentration may not represent the test of the parental animals used in these experiments. In fact the wide variation of either the Guernsey or Holstein-Friesian breeds in this respect make it entirely probable that such is the case. The experiments are interesting however in that wide differences are represented in butter-fat percentages of the two breeds. The average butter-fat percentage of the Holstein-Friesian parents was assumed to be 3.3 per cent. The average test of the Guernsey parents was 5.0 per cent. The F_1 crossbred cows had an average butter-fat percentage of 4.08 or were intermediate between the two parental breeds approaching the lower testing Holstein Friesian parents more closely than the higher testing Guernsey parents. The outcome of these experiments despite the many uncontrolled variables is in essential agreement with the experiments herein reported from the Maine Station.

BUTTER-FAT PERCENTAGES COMPARED TO MILK YIELD

It is of interest to examine the results of these experiments on butter-fat percentage in the light of those for milk yield. It will be remembered that in the F_1 crossbreds milk yield was intermediate between that of the high and the low parents but approached most nearly that of the high parent. In the genetics of many economic characters as yield of grain, size of the animal etc. the explanation used to account for such a phenomena is the heterozygous nature of the factors contained in the F_1 animal as compared with the homozygous nature of the factors in the parental breeds or strains. Without question there may be something to this hypothesis for certain crosses. The results for milk yield and butter-fat percentage do present a paradoxical position when this hypothesis is applied to them. Thus milk yield is increased over what the true intermediate should be. This follows the expectation generally agreed upon and accounted for by heterosis. But on these identically same animals the butter-fat percentage is decreased below the intermediate. This is not the expectation generally considered as due to heterosis although it is by no means impossible to assume that increased vigor may reduce rather than increase a character. The double nature of such a position does not appeal to the author, however, as furnishing more than a verbal explanation of the results having little parallel in the rest of genetics. The explanation which really seems most likely is that we have in these two cases the resultant of partially dominant factors. Numerous similar cases can be cited in genetic literature. Perhaps the best known case is that of black in Drosophila where the factor for this is normally classified as a recessive but where if occasion demands it may be

[6] Dunne, J. J.
1914. Hereditary Transmission of Fat Percentage. Hoard's Dairyman. Vol. XLVII. No. 15, pp. 553.

[7] Castle, W. E.
1919. Inheritance of Quantity and Quality of Milk Production in Dairy Cattle. Proc. Nat. Acad. Vol. 5, pp. 428-434.

used as a dominant; such a factor differs quite distinctly from another like speck which is consistently recessive. Such a parallel will explain the inheritance for butter-fat percentage by considering that the factors for low butter-fat percentage display more dominance in their expression than do the factors for high butter-fat percentage.

The inheritance of butter-fat percentage has occupied a prominent place in the discussions of breeding operations by practical dairymen. These men have held the following views as to the mode of this inheritance. The first has claimed that the tendency for high or low butter-fat percentage is transmitted by the sire to his offspring; the second that the dam transmits the tendency for high or low butter-fat percentage to the offspring; and the third that both parents contribute to the butter-fat percentage transmission. The results of these experiments show that the third of these claims is correct. Such being the case the dairyman who wishes his breeding operations to progress successfully will find it desirable to examine both sides of his animals' pedigrees carefully. Thus, today, the Jersey breeder pays a good deal more attention to the sires' side of the pedigree than he does the dams' side of the pedigree when in truth both sides are equally important.

REMARKABLE INDORSEMENT OF THE JOURNAL OF HEREDITY BY THE CHIEF OF THE BUREAU OF PLANT INDUSTRY

Dr. Wm. A Taylor is the Chief of the largest plant research organization in the world—the Bureau of Plant Industry of the U. S. Department of Agriculture. Its large staff of trained research workers, backed by an extensive clerical organization, constitutes the most powerful creative force in the study of plants which the world has ever seen. It expends $2,800,000 a year, which would represent an endowment of more than twice that of the Carnegie Institution.

This unrivalled body of research workers has gathered together thousands of invaluable photographs which tell the story of new discoveries better than words do. There has never been any adequate way to bring these illustrations before the public, and this year the totally inadequate source of publication has been cut in two.

In a similar way, the large army of research workers all over the world who find that their mediums of publicity are being hampered by inadequate facilities, are looking to the JOURNAL OF HEREDITY as the means by which they may present their discoveries to the interested public.

Dr. Taylor's indorsement, printed on the opposite page, should appeal to everyone interested in the building up of our plant and animal industries. The production through breeding and selection which is actually going on is creating for the country hundreds of millions in wealth. Increased production, more disease resistant plants, longer, tougher fibred, better flavored and otherwise more valuable tobaccos, cottons, rices, wheats, sorghums, corns, peanuts, watermelons, peaches, potatoes, oats, barleys, flax, blueberries, citrus fruits—in fact the whole range of agricultural and horticultural plants—are actually being effected by the workers in this new field of science, and when Dr. Taylor says that no other scientific journal in America equals the JOURNAL OF HEREDITY in respect to its power to communicate and preserve the basic information relating to plant and animal improvement, he speaks from a quarter of a century's intimate experience with the conditions as they are.

The JOURNAL OF HEREDITY has an appeal to everyone who wants to see the photographs which show the progress in this field which is easily and rapidly becoming one of the greatest of all in its ability to create wealth.

Department of Agriculture,
Bureau of Plant Industry,
Washington, D. C.

November 6, 1920.

Dear Dr. Fairchild:

In your consideration of the future of the Journal of Heredity I hope you will not overlook the very important relation to practical agriculture which the Journal has developed. While its title hardly suggests it, and I am free to confess when its publication began I personally did not expect it, the Journal has become a very effective medium for the communication and preservation of much basic information relating to plant and animal improvement. No other scientific journal in America equals it in this respect, nor do the official channels of publication such as those of the Department of Agriculture and the State Agricultural Experiment Stations hold out any promise of meeting this need.

The catholicity of its editorial policy, coupled with the quality of its illustrations, is rapidly making it the most important journal for plant and animal breeders in the country at a time when these basic activities in agricultural development need it most keenly.

I sincerely hope that the Association will find it possible to continue the issue of the Journal without abridgment of quality or frequency of issue.

Sincerely,
(Signed) Wm. A. Taylor.

Dr. David Fairchild, President,
American Genetic Association,
Washington, D. C.

A HERD OF ALBINO CATTLE

J. A. DETLEFSEN

College of Agriculture, University of Illinois, Urbana

ABOUT six years ago, Mr. Martin Kaslow of Mora, Minnesota, obtained two albinotic calves—a bull and a heifer. The calves were the result of mating a so-called full-blooded Holstein bull to grade Holstein cows. The parents were of normal coat color, black and white spotted. Unfortunately, the bull was killed before his offspring were born. Mr. Kaslow was attracted by the beautiful white coat and pink eyes of the calves and proceeded to make matings for the purpose of increasing the number of albinos. He was entirely successful in his efforts and secured a score or more albinos in the course of a few years.

My attention was drawn to this interesting herd through the courtesy of Professor H. K. Hayes, of the College of Agriculture, University of Minnesota, and I corresponded with the local county agent and Mr. Kaslow to obtain details of the case. Unfortunately, Mr. Kaslow's records were destroyed in a fire, and the following comments depend on his memory to a large extent, supplemented by such observations as I was able to make when opportunity was afforded to examine the herd. While not questioning the correctness of the data, I can not vouch for their accurary, since they depend upon a memory of events which took place during the course of several years. However, since the herd is quite unique, at least a record of its existence should be made.

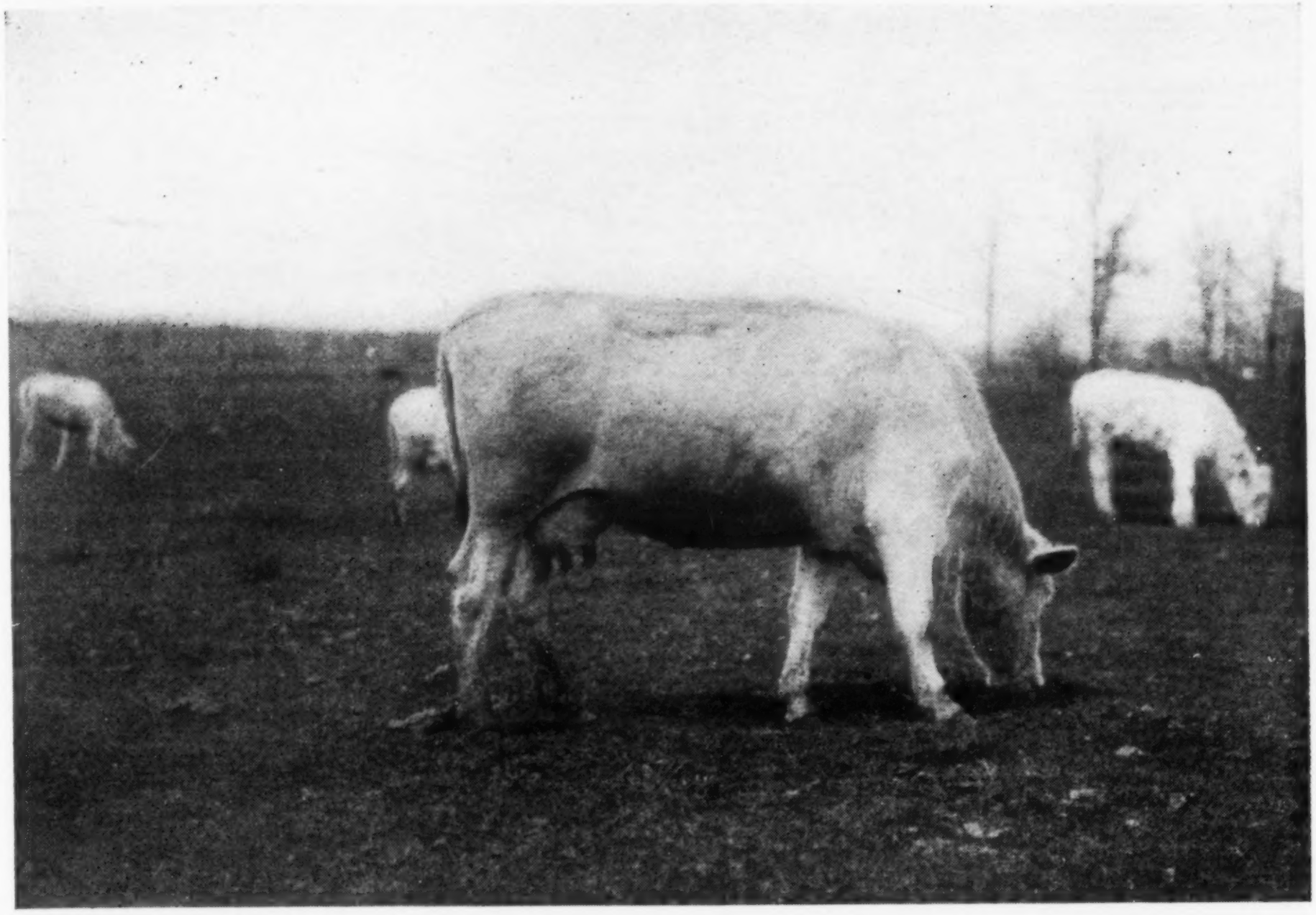
UNUSUAL RECORD OF ALBINO BULL

The original full-blooded Holstein bull was mated to about twenty unrelated grade Holsteins producing a bull and a heifer albino, and the rest normal. In the absence of more data, the case would appear like other simple cases of albinism in which a heterozygous male was accidentally mated to similar females and naturally some albino segregates appeared. But the subsequent matings, according to Mr. Kaslow's statement, do not bear out such a simple hypothesis, for the young F_1 albino bull was mated back to the grade Holstein cows and produced only albinos—about twenty in number. If Mr. Kaslow's observations are correct, the case is rather remarkable, for an original mating of normal-coated Holsteins gave an apparent recessive segregate—an albino bull. And yet this bull acted like a homozygous dominant in matings with normally-coated Holstein cows.

Mr. Kaslow states that the albinos, when mated *inter se*, have given only albinos and exhibited four young albino calves which were reported to have come from such a mating. Furthermore, four albino females were mated to a registered Holstein bull and produced three albinos and one normal Holstein.

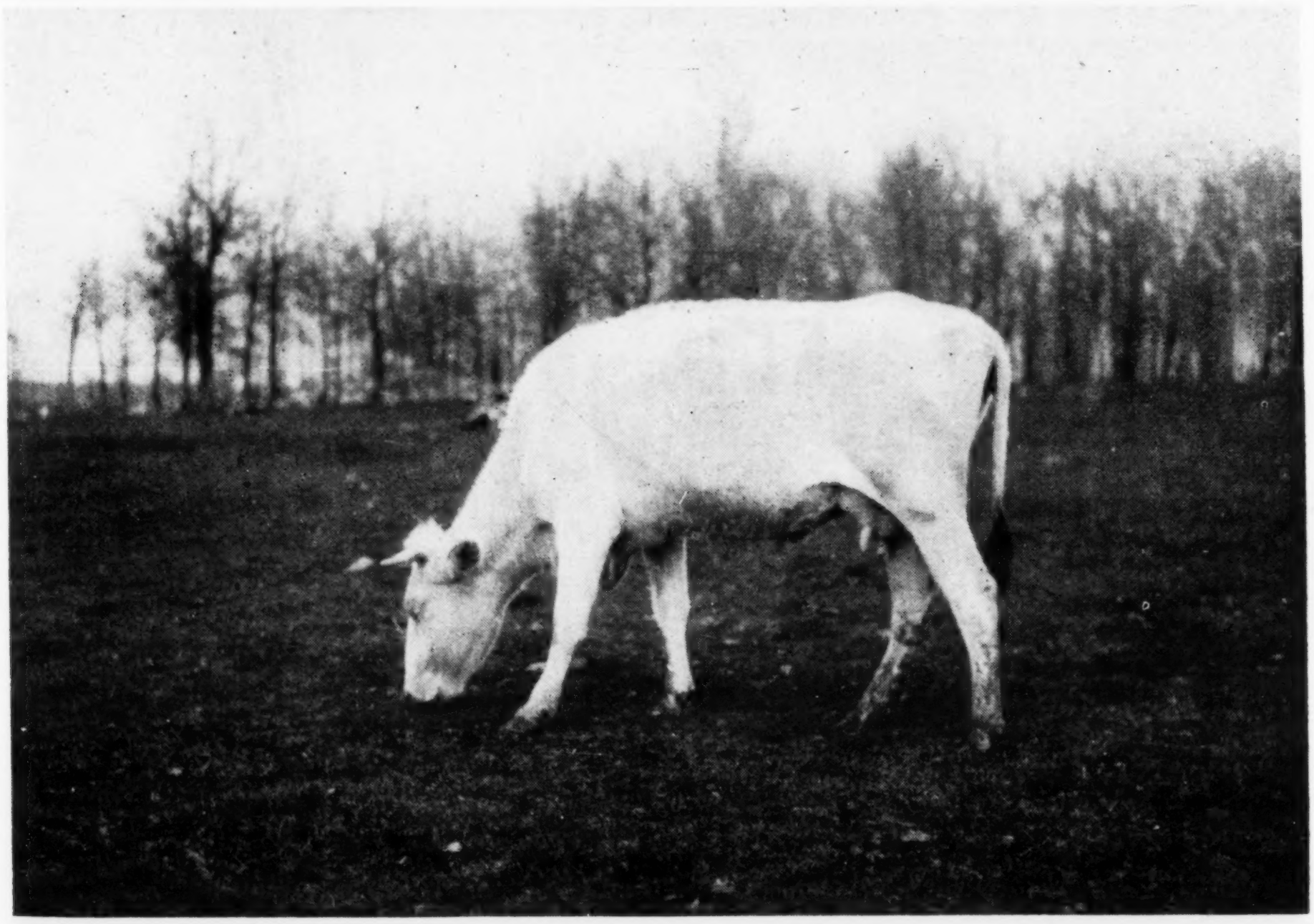
NOT CORRELATED WITH MILK PRODUCTION

As far as I could determine by examination, the albinos showed no pigment in the skin, eyes, horns, or hoofs, except in one case. One adult female had a small black spot about one centimeter square on one ear. Mr. Kaslow had not noted any similar appearances of pigment in other individuals and was somewhat surprised when this case was pointed out to him. The albinos were extremely sensitive to light and grazed in a listless manner during the daytime with their eyes partly closed and their pupils contracted. In the evening, the vision was apparently normal, and the albinos showed much more animation. The albino character seems to be uncorrelated with milk production for this albino herd produces about the same amount of milk expected of similar grades.



ALBINO CATTLE

A full-blooded Holstein bull mated to about twenty unrelated grade Holstein cows produced two albino calves, the rest of the offspring being normal. Subsequent matings increased the number of albinos to twenty or more. The herd furnishes an interesting case of albinism. (Fig. 26.)



ATTRACTIVE WHITE COAT AND PINK EYES

Examination of the herd showed no pigment in the skin, eyes, horns or hoofs. The cattle were very sensitive to light, and grazed more actively in the evening than in daytime. (Fig. 27.)

DETERIORATION IN SOME HORTICULTURAL VARIETIES THROUGH DEFICIENT ARTIFICIAL SELECTION

H. H. M. Bowman
Biological Laboratory, Toledo University

THE following data have been gathered during the summers of 1917, 1918 and 1919, and when analyzed would seem to indicate that these horticultural varieties of several decorative plants, chiefly annuals, have seriously deteriorated from their type standards. An attempt to inquire into the causes for this deterioration leads one to believe that the fault lies with the producers of the seed and their failure to maintain careful artificial selection in breeding these varieties. It is assumed that the war and the consequent labor conditions are to account for the situation. The observations here presented may also be of use to indicate the more labile characters in these particular varieties and possibly by thus analyzing their hereditary constitution, material may be secured in them for genetical studies.

UNIFORM METHODS OF CULTIVATION

For many years it has been the writer's privilege to cultivate each summer at his home in eastern Pennsylvania, a small garden containing many varieties of herbaceous and shrubby perennials and bulbous plants. In the more open borders are usually planted the common annuals and biennials, such as asters, poppies, zinnias, marigolds, balsams, pansies, mignonette, delphiniums, etc. The seeds for these plants have annually been purchased from the largest and most reliable seedsmen in the East and have always produced excellent results. In some instances *Centaureas*, *Scabiosa*, seedling *Dahlias* and *Salpiglossis* have been exhibited. The soil and ordinary cultural methods have been practically the same for a long period, and with good seed from reliable sources the conditions, so far as germination and growth are concerned, have been unchanged in the successive seasons. All these conditions, therefore, being so uniform, any extraordinary variation in results good over a long period preceding would, naturally, not be due to the cultivation. The explanation must be sought in the seeds.

The same varieties were grown in the two summers preceding that of 1919, and the same deterioration was observed in these particular varieties, but even in a more marked degree was it noticed in the season mentioned. As the observations were more carefully taken this past summer, only the data for that period are here set forth. In the spring of 1919 seeds were purchased of named varieties of the China Aster, *Callistephus chinensis*, *Zinnia elegans; Tagetes erecta*, the African marigold; *Matthiola incana* and the corn-flower, *Centaurea cyanus*, together with seeds of other decorative plants and garden vegetables. These named varieties had been bought of the same firm in the preceding years and were planted under similar conditions in the same garden, and all germinated with excellent percentages.

Before proceeding in detail with the results of the plantings of the genera named above, it should be mentioned that the crops produced from vegetable and other seeds were in the highest degree satisfactory and that these seeds were evidently up to the standard of previous years. The need for propagating large quantities of food plants during the war period obviously was an incentive for breeders to maintain as high a standard of quality as possible.

EVIDENCE OF DEGENERATION IN SEEDS

The asters were of three varieties—white, pale pink and lavender in standard named strains. The florets have long and slightly twisted rays or ligules of the type popularly called "Chrysanthemum" asters. The seed germinated in good time with 97 per cent viable plants when set out, and the plants immediately made good growth.

The season was very favorable and the usual fungicides and insecticides applied prevented the attacks of pests, so that late in August the asters came into bud prolifically. So far these plants were identical with those of the same strains grown in other seasons. But first of all it was noted, when the heads began to expand, that, though equal plantings had been made of all three colors, only a scant proportion of the plants were of the pale pink color, indicating that, of the seeds so labeled, only a few really carried the factor for that color. This may have been an error originating in the packing of the seeds but on account of the presence of some of the desired color, and that in varying degree, it could be assumed that the strain was not carefully segregated in breeding at the seed farm and that the phenomenon was really genetic.

A more striking evidence, however, of the deterioration of this stock was seen in the form of all three colors. The ray florets had much shorter ligules and with a less pronounced curl so that the flowers were scarcely recognized as being of that distinctive named variety. The plants were strong and well nourished, but these asters had degenerated in regard to length of the ligules and the amount of "curl" in them and were losing the character for "pinkness."

VARIATIONS IN ZINNIAS

The *Zinnia etegans* strain was of a type normally having tall-growing stems and full double flowers and characterized especially by long peduncles. The latter feature is desirable in this type of *Zinnia* so that it may be used for cutting. The more dwarf bedding sorts have shorter internodes and shorter peduncles, thus giving a mass effect of bloom. Instead of these *Zinnias* coming true to their varietal characters, with long internodes and peduncles, there was a pronounced shortening in these axes, although the plants attained a good size and luxuriant growth and all signs of any depauperation were absent, both in the synthetic tissues and the inflorescences. There was a tendency also for these *Zinnias* to revert in color to the reddish magenta of the ancestral type indigenous to Mexico, and in form to produce some disk florets in the center of the very large heads mainly composed of ray florets with very broad ligules, instead of the full double form with densely packed heads of ligules all of a uniform size. The *Zinnia* may then be said to deteriorate in the shortening of the internodes and peduncles and reversal to fewer rays and purple color.

THE AFRICAN MARIGOLD

Tagetes erecta, the African marigold, is an especially easy annual to grow. With ordinary good culture it will produce large full-double heads which frequently become too heavy for the peduncle and break under their own weight. The well grown plants of the 1919 season set an abundance of buds but the lack of uniformity in the stature of the plants in the same plot presaged differences in inheritance of these various individuals. In one plot specimen plants had been set out two feet apart, so the ample room for development was assured each plant, but here too the same variations in stature occurred. That the strain was contaminated with a dwarf type, perhaps even mixed with another species, as *T. patula* or *T. signata*, would account for this variation.

The two varieties selected for planting were tall growing sorts of two shades, one a clear yellow and the other a deeper orange. The fact that as many plants of the lighter color reached maturity as of the darker color, in

proportion to their occurrence in the population, indicated again that there was no adverse factor in the cultural methods, since the paler varieties are less hardy and succumb to hard conditions more quickly than the deeper tinted varieties in species having the normal types colored (as de Vries[1] and others have pointed out) or in which the ancestral form is a deeply colored species. A survey, however, of the whole population of these marigolds showed that there was a far greater proportion of the orange tint. Since the germination percentage was very high, almost every seed having been viable, and no plants were lost in setting out, the conclusion is drawn that the paler type had been overcome in breeding and was masked by the more dominant or atavistic orange factor. This variation in stature and small proportion of clear yellow tints had already been observed in the plants grown in 1917 to a marked degree.

In the named types of these marigolds the peduncle is somewhat expanded at the inflorescence to form an urn-shaped cup and the ray florets surrounding the edge of this cup develop first, a capitulum, of course being an indeterminate inflorescence. The inner florets grow up from the more central part of this involucral urn and in the perfect type of these varieties there is a great elongation of the ligules of the central florets, so that the whole head represents a highly piled mound of rays with graduated lengths of ligule increasing from the circumference to the center. In the plants grown during the last three years, the central florets either reverted completely to the original species form of disk florets, with tubular corollas, or if the ligules were retained they did not elongate, so that the peduncular urn bore only one or two rows of rays about its circumference, and the center was a descending hollow of undeveloped or partial ligules.

Budding and additional food did not help matters or produce the large head of full ligulate florets. It illustrated the tendency in *Tagetes* to go back to a simple composite type with dimorphic corollas within two or three generations of deficient artificial selection. The special feature showing, perhaps, most deterioration was the failure of the central ligules to elongate, thus forming sort of funnel-shaped inflorescence or the complete reversal to the disk type. In passing, it may be remarked that the plants were most prolific in setting seed, which is only another evidence of deterioration in highly bred or hybrid stock.

EARLY VARIATIONS IN THE STOCKS

The stocks, *Matthiola incana*, were sown early and set out under the most favorable conditions in an open bed with considerable space about each plant. By mid-summer each had become a sturdy tufted specimen-plant with a strong woody base. Later, when the inflorescences began to form, these plants gave every promise of what should have been dense trusses of double blossoms in tints of pink, red, yellows, white, lavender and purple. An early indication of variation was noted, however, in these plants when the leaves of adjacent plants were compared. The foliage of the type is densely tomentose but in these individuals all stages were found—from heavy gray velvety tomentum to an almost completely glabrous condition. Considerable variation was also observed in the width of the leaves. When the rather loosely arranged spikes and the blossoms were fully developed, it was a surprise to find that the color range included only the white, lavender and purple. The more delicate rose, pink and yellow had all been submerged in the dominant purple. The petals were broad and most of the stamens perfectly developed and the inflorescence bore flowers almost the entire length of its usual tetramerous form, but with very few petaloid stamens. In these Stocks, just as in the marigolds, the heterozygous strains were very prolific and matured abundant seed. In *Matthiola*,

[1] de Vries: Mutationstheorie—*Oenothera Lam.* var. *albida*.

then, we have evidence of considerable reversal to the simple cruciferous ancestral forms which were presumably purple, and signs of mixed heredity in high degree of fertility and the variations in the foliage.

THE CENTAUREA

In the *Centaurea* the type was of a very deep blue color with at least three or more rows of false rays. Reversal was seen in over fifty percent of the plants in the population of this sowing, as the heads had only one, or at the most, two rows of false rays and an increase of functional disk florets. In color also there was evidence of contamination of the strain. Beside the deep blue of the type there were all shades of lighter blue, as well as white, pink and maroon, showing that this strain had not been carefully selected and segregated at the seed-farm.

CARELESS SELECTION OF SEED-PARENTS

In all these foregoing examples, it may be deducted that many standard horticultural varieties have considerably deviated from their types. In these particular cultures the fact that the growth conditions were uniform, and other factors which would have lowered the vitality of the generation, such as fungous and bacterial diseases, were absent, should be conclusive evidence that causes for this deviation have been inherently genetic, i.e. that the seed was of poor quality and contaminated with other and dominant inferior strains, or that there was a general lowering, reverting and atavistic tendency due to unknown physiological conditions at the breeding farms, which has affected the germplasm of these varieties.

In regard to careless selection by the breeders of the seed-parents having the desired characters, or perhaps the failure to keep up the nutrition or some other cultural condition on the farms, or the lack of careful and skilled pollination, much, or perhaps all, can be attributed to the war—directly due to the lack of labor on the seed-farms; but in all events this deterioration in stock has occurred and it may be several years until these strains are again recovered or are replaced by new ones.

WHAT THESE OBSERVATIONS INDICATE

Another and rather interesting feature of these observations was the recognition of those hereditary factors in these particular varieties which are least fixed or stable in the constitution of these plants. Some of these have become conspicuous by their complete disappearance or modification. On the other hand those characters which are dominant and persist to the last may only mask or cover those more unstable characters which apparently have disappeared.

Of course, from a purely genetical point of view, these horticultural varieties are far removed from the simple strains of known heredity which are usually chosen as material for genetical investigation and research. Most all horticultural varieties are sports or the results of very complex hybridizations and cross pollinations, and if actual inbreeding experiments should be carried on with them through four, five or more generations for the segregation of Mendelian characters, all sorts of peculiar results might be expected from these much mixed and heterozygous strains.

In conclusion, then, it may be repeated that these observations perhaps indicate some of the less firmly fixed characters in the heredity of these varieties which have undergone a deterioration from their standard types.

MEETING OF GENETICISTS INTERESTED IN AGRICULTURE

The place of genetics in the curriculum in agricultural colleges, and cooperation in genetic investigations, were among the several subjects discussed in a special meeting of geneticists held in Chicago December 28th in conjunction with the meetings of the American Association for the Advancement of Science and affiliated societies.

Among the speakers at the meeting were Professors L. J. Cole of Wisconsin, J. A. Detlefsen of Illinois, R. A. Emerson of Cornell, E. B. Babcock of California, S. A. Beach of Iowa, M. J. Dorsey of Minnesota, and D. F. Jones of Connecticut. Fifteen Agricultural Colleges and Experiment Stations, besides the U. S. Department of Agriculture and other institutions, were represented.

A resolution was adopted favoring the establishment of a single department of genetics in agricultural colleges. Many institutions now have their instruction and research in genetics scattered throughout many departments with no one department responsible for a fundamental course. To simplify administration and prevent duplication, and give proper standing to the subject of genetics in the curriculum, it is recommended that each institution have a department of genetics to handle the courses of instruction and direct the investigational work, and cooperate with, but not control, investigational work in the specialized problems of genetics.

SECOND INTERNATIONAL EUGENICS CONGRESS

The Second International Eugenics Congress will convene in New York City September 22, 1921. It will be a conference on the results of research in race improvement. The First International Congress was held in London in 1912. Since then the world war has come and gone, leaving the economic, sociologic and biologic conditions everywhere greatly disturbed. Never before has the need of international cooperation and enlightenment been felt so keenly. The Second Eugenics Congress is therefore meeting at a time of exceptional interest.

The conference will be divided into three sections. In the first, the results of genetic research in animals and plants will be presented, and also studies in human heredity. The second section will consider factors which influence the human family, and their control, and the third will concern itself with the topic of human racial differences—the influence of racial characteristics on human history and their bearing on the policies of the future, modern immigration being especially set forth.

Representatives from nearly every country of the world are expected to be at this congress. The Secretary-General is Dr. C. C. Little, American Museum of Natural History, New York City.

GENETICS AND EUGENICS

"Genetics is the science which seeks to account for the resemblances and the differences which are exhibited among organisms related by descent."

"Eugenics is the study of agencies under social control that may improve or impair the social qualities of future generations, either physically or mentally."

"An exact determination of the laws of heredity will probably work more change in man's outlook on the world, and in his power over nature, than any other advance in natural knowledge that can be clearly foreseen.

"To gain this knowledge is the object of the science of genetics. which proceeds in practice, largely by means of plant breeding and animal breeding for the reason that heredity is less complicated in these organisms than in man, and its operation can be more easily made out. The knowledge so gained finds its application in methods for the improvement of cultivated plants and domesticated animals and, most important of all, in the improvement of the human race, through the science of eugenics."

GENETICS LITERATURE

The annual reports of the American Breeders' Association, published in seven volumes, form one of the most valuable collections of material for students of genetics which has been published in the United States. Volumes I to V are no longer available, but the Association still has on hand a few copies of Vol. VI for sale at $1.00 and Vol. VII-VIII at $1.50.

The Association desires to purchase copies of Volumes I to V of the Proceedings A. B. A., and will be glad to hear from anyone having copies for sale.

Former issues of the JOURNAL OF HEREDITY, so far as they are available, are for sale at 25 cents each, postpaid.

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